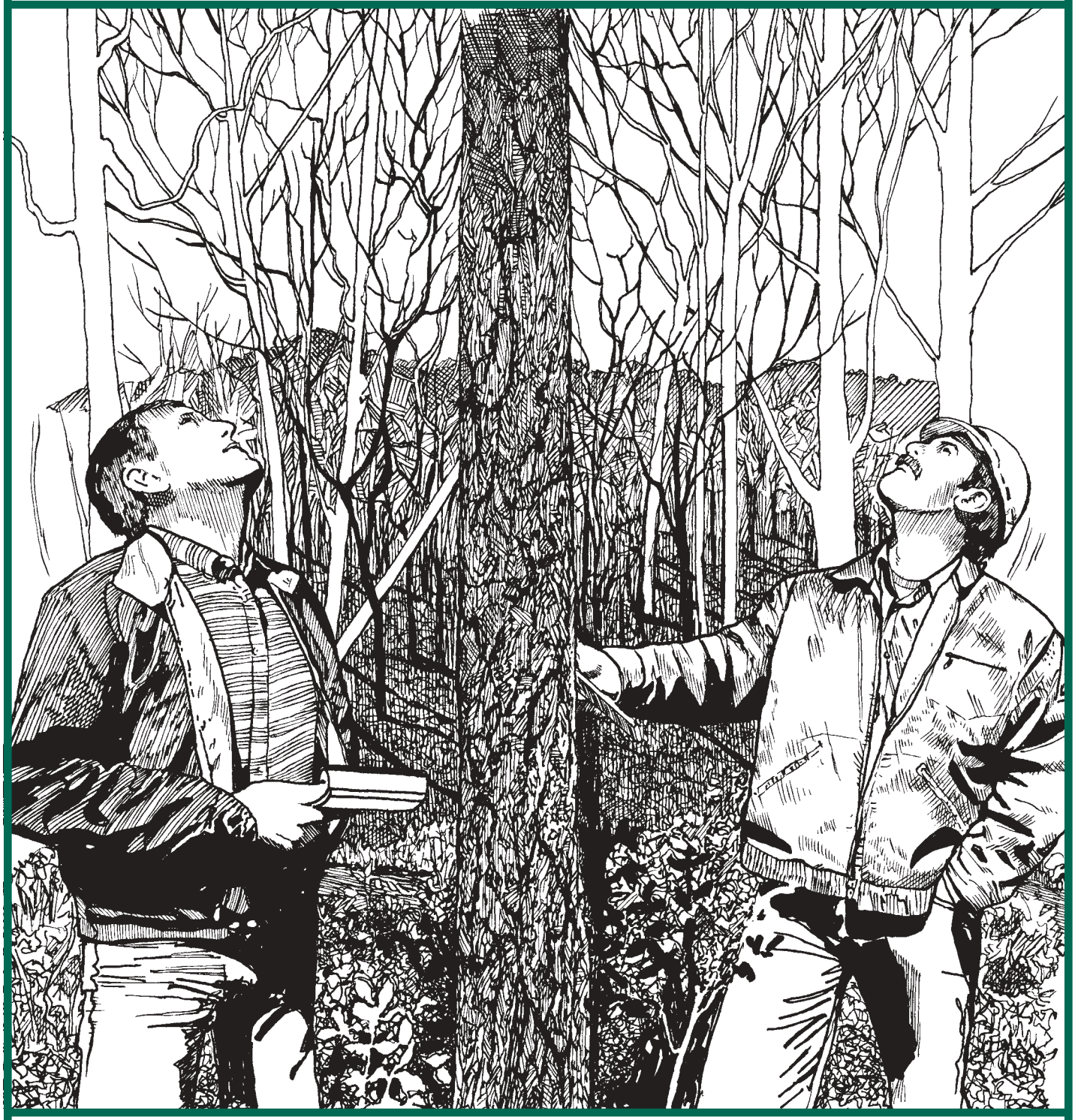
Forest Management

for Missouri Landowners



Missouri Department of Conservation

The Missouri Department of Conservation uses federal financial assistance in Sport Fish and/or Wildlife Restoration. Because the state uses these federal funds, it must comply with federal anti-discrimination law. Under Title VI of the 1964 Civil Rights Act and Section 504 of the Rehabilitation Act of 1973, the federal government prohibits discrimination on the basis of race, color, national origin, disability, age or sex. If you believe that you have been discriminated against in any program, activity or facility as described above, or if you desire further information please write to the addresses below:

The Office for Human Resources
U.S. Fish and Wildlife Service
Department of the Interior
Washington, DC 20240

Missouri Department of Conservation
P.O. Box 180
Jefferson City, MO 65102-0180

Published by the Missouri Department of Conservation

Web address: www.conservation.state.mo.us

Forest Management

for Missouri Landowners

Written by Bruce Palmer
Edited by Joan McKee

Illustrations by Dave Besenger, Steve Gum, Rich Guyette, Diana Jayne, Alec Ramlow, Mark Raithel and Charles Schwartz

Acknowledgments


American bladdernut

Many good references are available to help private landowners manage their forest land. Some of these include other Conservation Department publications, Extension Guides and U.S. Forest Service research notes. This book is a combination of original work and excerpts from some of these sources. Being a firm believer in not reinventing the wheel, I would like to acknowledge the following authors, whom I have freely drawn upon for sections of this book.

"Woodland Stewardship" by Melvin Baughman, Alvin Alm, A. Scott Reed, Thomas Eiber and Charles Blinn, Minnesota Extension Service

"Tax Considerations" section by Gregory R. Passewitz, School of Natural Resources, The Ohio State University

"Timber Management for Small Woodlands" by Gary Goff, James Lassoie and Katherine Layer, Cornell Cooperative Extension Service

"Central Hardwoods Notes," F. Bryan Clark, editor, U.S. Forest Service

"Wildlife Management for Missouri Landowners" by David E. Pitts and William D. McGuire, Missouri Department of Conservation

"Missouri Watershed Protection Practices" by Lynn Barnickol, Missouri Department of Conservation

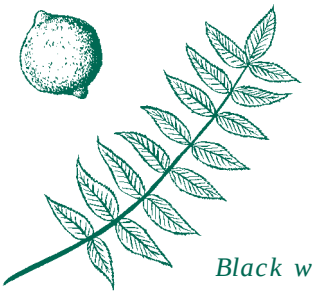
"Marketing Timber" by Mark Nelson, Missouri Department of Conservation

"Special Forest Products" by Shelby Jones, Missouri Department of Conservation

"Woodland Ecology" by Leon Minckler, U.S. Forest Service

Miscellaneous University of Missouri Guidesheets by Julie Rhoads and John Slusher, School of Natural Resources; Carol Trokey, U.S. Forest Service; and Fred Bergman, Missouri Department of Conservation

Introduction



Black walnut

Missouri is one of America's great forested states, ranking seventh of the 20 northeastern states in the amount of forest land. Forests cover about a third of the state and contain some of the finest oak, walnut, pine and redcedar found anywhere.

Forests are Missouri's greatest natural resource, providing many economic, environmental and social benefits. They protect hillsides from erosion, keeping streams and rivers clean. They filter the air, soften the extremes of the weather and add beauty to cities and towns. Much of Missouri's recreation and tourism industry is centered in the forested regions of the state. Forests also are a diverse resource of plants, animals, birds and other life forms.

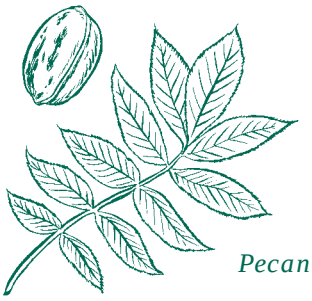
Forest products are important to Missouri. Harvesting and processing trees into wood products gives thousands of people jobs and contributes about $3 billion each year to Missouri's economy.

Because 85 percent of Missouri's forest land is owned by private landowners, you might think that most of the social, environmental and economic benefits of forests would come from private woodlands. Unfortunately that is not the case. Very few forest owners ask a forester to look over their woodlands. Even fewer have a written forest plan to help guide their land management activities. Foresters also can help landowners get better prices for their timber, but only about 10 percent of the timber sales in the state are conducted with their assistance.

This book is a first step toward getting more from your woodlands—whether you are interested in wildlife, wood products, recreation or scenery. It will give you guidelines for assessing the present condition of your forest and ideas for creating and maintaining a healthy forest that meets your objectives. Still, there is no substitute for a professional opinion. Foresters from the Missouri Department of Conservation are available free of charge to help answer your forest management questions. Private consulting foresters offer the same services on a fee basis.

According to an old proverb, "The best time to plant a tree is 20 years ago. The next best time is today." The same applies to managing a forest. The sooner you get started, the sooner you'll start reaping the benefits.

Table of Contents



Pecan

What is Forest Management?


Black oak

Forest management is providing a forest the proper care so it remains healthy and provides the products and benefits the landowner desires. It is different than timber management, where the focus is primarily on producing wood fiber.

Forest management considers all parts of the forest community: soil, water, plants, animals and birds, as well as the trees. The aim of forest management is a healthy, sustainable forest that accommodates any number of uses by the landowner.


Aesthetics

Recreation


Wildlife

Fuel


Special products


Water quality


Paper products


Windbreaks


Employment


Lumber

Preparing a Forest Management Plan

What will you do with your woodland? As someone who owns forest land, you have a decision to make. You can do nothing. You can occasionally do things that generate income or improve the property's appearance. Or you can actively manage your land for personal benefits, while protecting the quality of its natural resources—soil, water, wildlife, trees and other plants—for future generations.

Forests are a renewable resource, but they require many years to mature. Decisions you make now about timber harvesting, tree planting or pest control can influence the character of your woodland for the next century. In managing a woodland, you need to plan for the long term because whatever you do—or don't do—will impact the future.

A forest management plan will help you determine your personal objectives, manage efficiently, avoid costly errors, make knowledgeable decisions and evaluate your progress. This chapter describes how you can create a plan for your woodland. You may need to work with a forester to complete certain steps.

Step 1: Decide what you want

The first step is to develop a list of objectives. What do you want from your woodland? How much do you want? When do you want it? Your management choices will be clearer if your objectives are specific. For example, to improve the land for wildlife may be too vague of an objective to guide you toward sound decisions. On the other hand, an objective to increase the number of turkeys on the property may lead to some very specific management practices.

When you have multiple objectives, be sure to set priorities. Some objectives will be compatible given your resource base, but others may not. Many times only one objective can be maximized. You may not be able to develop realistic objectives until you conduct an inventory, which will help you learn more about the capability of your woodland. See below for details.

Step 2: Find out what you have

The next step is to inventory your forest to determine what resources you have. Since a forest is dominated by trees, an inventory usually assesses the tree species composition, stand density, age, tree diameters, heights, quality and growth rates. Other resources also can be inventoried depending on your objectives. Working with a forester or biologist, you can expand your inventory to assess wildlife and fish habitat or other renewable natural resources. For example, the inventory can identify important sites for wildlife breeding, nesting, food, water and cover.

Although your woodland is just one part of a broader landscape, cumulative effects of management decisions by you and other landowners can greatly alter the landscape over time. Thus, as a part of the inventory process, you should identify land uses on property that adjoins yours and find out what plans your neighbors have for managing their land. This will better enable you to evaluate the impact your forest management activities may have on the landscape. Coordination among neighbors can produce a landscape that meets individual landowner objectives without adversely affecting the environment.

Your inventory results can be useful in a variety of ways. A forester can use them, along with your objectives list, to advise you about alternative management practices and their consequences. An inventory also may help you report and minimize your federal income taxes if it is conducted when you first acquire the property.

Before you begin an inventory, accurately locate and clearly mark property boundaries with a fence, paint marks on trees, signs, posts or other means. If boundaries are not clearly

identifiable, you may need to have your land surveyed.

Next, draw one or more maps of the property, approximately to scale, showing the following:

- Property boundaries
- Forest boundaries
- Other land uses such as crop fields and pastures
- Roads and trails
- Utility lines, pipelines or other rights of way
- Buildings
- Ponds and streams
- Unusual natural, historical or archeological resources.

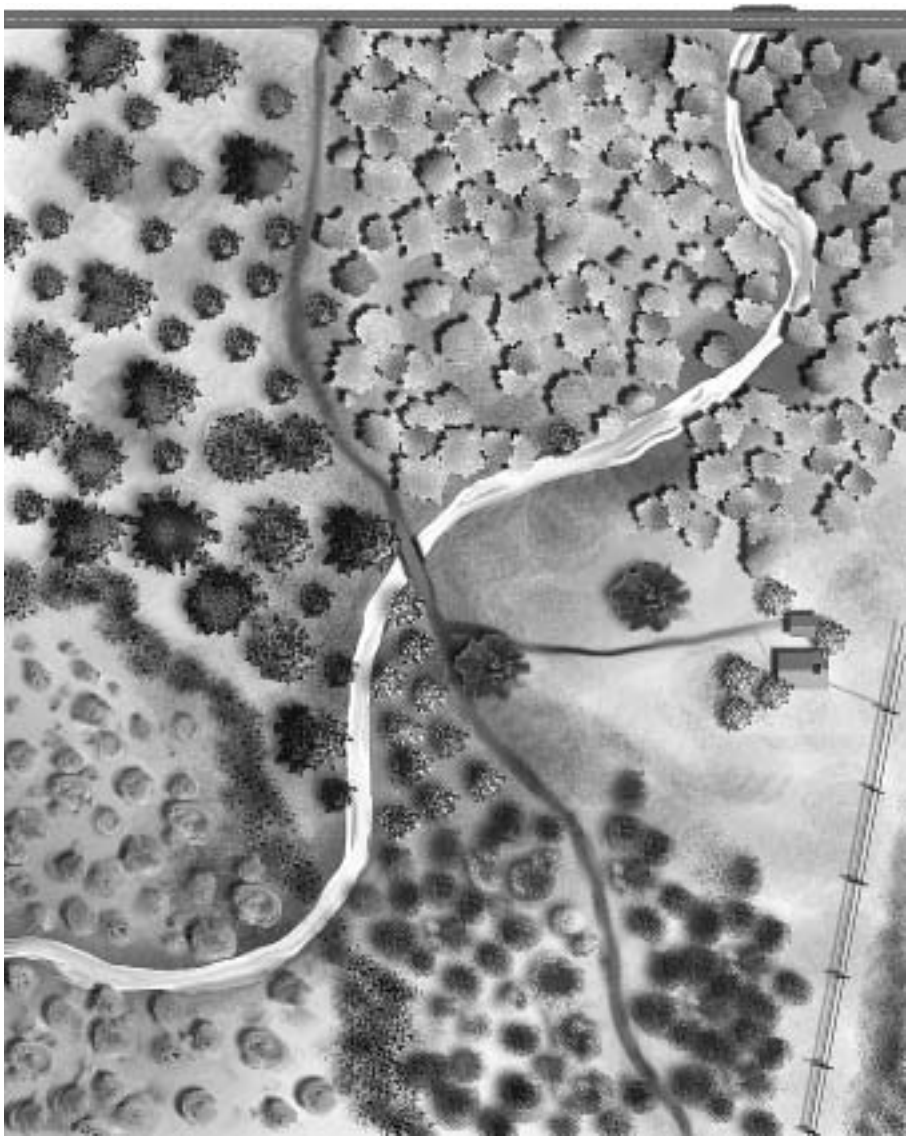
Aerial photographs are especially helpful as a foundation for the map. They usually are available from the local office of the USDA Farm Service Agency.

If the property is large and hilly, topographic maps may help you assess slope and aspect as they relate to road location and tree growth. Topographic maps are sold by the U.S. Geological Survey, 1400 Independence Road, Rolla, Mo. 65401, and the Division of Geology and Land Survey, P.O. Box 250, Rolla, Mo. 65402. They also can be found in some sporting goods and outdoor stores.

Soil information can help you determine the suitability of your land for different tree species, road or building sites or other land uses. Soil type maps and interpretive information may be available from the local USDA Natural Resource Conservation Service office.

Gather facts concerning previous land use or management activities that could have influenced the development of your woodland. Such activities might include livestock grazing, agricultural cropping, timber harvesting, tree planting, fires and pest outbreaks.

Foresters use information about these events and their timing to analyze the development of existing woodlands and to predict the results of future management practices.



Stand boundaries usually correspond to natural or constructed features, such as streams, ridges, roads or fields.

During the inventory, prepare a map that separates the forest land into individual stands. Each stand will be an area of about 2 to 40 acres that is relatively uniform in tree species composition, tree size distribution, number of trees per acre (also called stocking) and site quality. Each stand is a management unit, and cultural practices are carried out more or less uniformly within a stand.

Step 3: Identify potential management practices

After you identify your objectives and have an inventory, consider all reasonable management practices that would help meet your objectives. They might include:

- Planting trees
- Improving the timber stand by thinning, crop tree release and pruning
- Harvesting timber
- Fencing
- Improving wildlife habitat
- Installing erosion control structures on roads
- Constructing access roads
- Developing trails
- Developing recreational facilities
- Establishing fire protection or prescribed burn fire breaks
- Controlling pests
- Controlling weeds and brush

Seek professional advice on which practices are appropriate for your woodlot.

Step 4: Assess labor and financial resources

Once you have developed a list of potential management practices, evaluate the labor and financial resources available to carry them out. Assess your ability and interest in various forestry practices. Consider how much time you are willing to devote to woodland management, when that time is available and how long you plan to own the land. What is the availability, cost and quality of contract labor?

Evaluate your financial situation, such as available capital, cash flow requirements, planning period, rate of return you would like to earn on invested funds and need for income or products for the woodland.

Finally, assess the availability of needed equipment, facilities and materials. All of these factors will influence what you can do in your woodlot.

Step 5: Develop an activity schedule

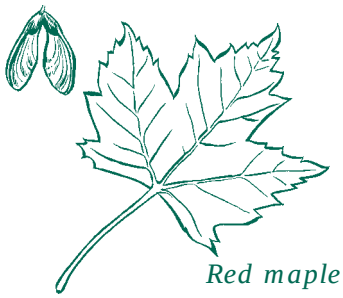
Next, prepare an activity schedule that lists management practices and when you expect to perform them. This schedule should cover at least five to 10 years. If your woodland is large—perhaps several hundred acres—activities may occur every year. If it is smaller, management activities may occur less often, perhaps only once every 10 years. Regardless of its size, inspect your forest at least once a year, more if possible. Walk through it and look for unauthorized harvest, damaged fences, soil erosion and damage by pests, fire or wind.

Step 6: Keep accurate records

It will be difficult to update your plans and make sound decisions about the future unless you keep accurate records of what you have done. Records also will be important when filing income tax returns and perhaps settling an estate. Management records may include:

- Management plan
- Timber inventory
- Management activities accomplished. List what, when and where.
- Sources of forestry assistance with names, addresses and telephone numbers
- Association memberships
- Suppliers of materials and equipment
- Contracts
- Insurance policies
- Forestry income and expenses
- Deeds and easements.

Taking Inventory



Red maple

Just as store owners must periodically inventory their merchandise, so must forest owners take stock of their trees. This procedure should be done before any management activities are begun. A typical forest inventory includes information on the acreage of forest land; the number, size, quality and species of the trees; and the stand's general vigor and health. Once the inventory is completed, it is possible to evaluate the woodland's current state and potential, and to begin thinking about management options.

The decision to do the inventory yourself or to use the services of a professional forester should be based on your ability and how the information will be used. An inventory that will be the basis for a timber sale should be as accurate as possible and may require the services of a forester to ensure a fair sale. On the other hand, you may be able to conduct the inventory yourself if all you need to determine is whether the stand is over-crowded.

Because woodlands often are viewed as a source of timber, an inventory usually focuses on assessing trees as potential wood products. Information obtained from the inventory, however, provides a snapshot that is equally valuable for assessing wildlife habitat, planning access roads or trails for recreation, and understanding the quality of your soil and water resources.

Organizing your woodland into stands

The first step of a forest inventory is to mark your property boundaries and obtain maps and aerial photographs as described in the previous chapter. Once you have marked boundaries and have accurate maps and photographs, it is possible to organize the forest into distinct management units, called stands.

Each stand requires specific practices based on the site characteristics, the tree species present and the age of the trees. Usually stand boundaries will correspond to natural or constructed features such as streams, slope and aspect changes, ridges, roads or fields.

There are three reasons for creating stands:

- Some stands require specific management activities. Each stand is managed to meet the requirements of both the site and the owner's objectives. For example, a stand of pole-sized hardwoods would be managed differently than a stand of nearly mature pines.
- Some stands may have greater timber-producing potential. Labor and capital should be concentrated on the stands that will yield the greatest amount of high-quality timber and, therefore, the highest financial return.
- Dividing the woodland into stands makes it easier to keep financial and work-progress records. It also allows the owner to set up a reasonable schedule for work in each stand and to set realistic goals.

Stands will vary in size from as small as 2 acres to as large as 40, depending on site and tree characteristics. Because past management may have influenced the condition of the trees presently on the site, dividing stands along topographic features is usually recommended. Trees found on the same soil, slope and aspect should grow similarly, and thus react to management practices about the same.

Once the stand boundaries have been established, the next step is to determine the tree species present, the number of trees per acre, the quality of the trees and the volume of usable wood. This type of survey is called a cruise.

Using this information, the owner can decide which management activity is best for each stand. For example, a stand containing young, densely stocked trees should be thinned, whereas a stand with many large, mature trees may need a regeneration cut.

Units of wood

The method and terms used to describe the amount of wood in a forest vary, depending on how the wood will be used. Wood used for lumber or veneer is measured in board feet. A board foot is a unit of wood 1 foot by 1 foot by 1 inch. The volume of a tree or log is the number of board feet of lumber that the log would produce when sawed. See Appendix 1 for more details.

Trees used for firewood are measured in standard cords. A standard cord is a stack of wood 4 feet high, 4 feet wide and 8 feet long. Because logs are irregularly shaped, the solid wood content of a cord averages about 85 cubic feet.

Pulpwood is measured by weight and cord volume. The weight of a standard cord varies greatly, depending on tree species and the moisture content of the wood. A cord of green oak weighs about 5,500 pounds, but only 3,800 pounds when air dry.

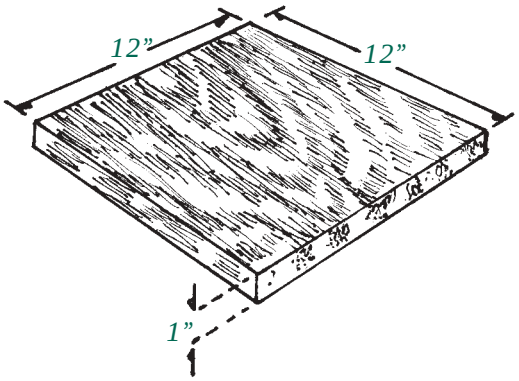
Measuring trees

By measuring a tree's diameter and height, it is possible to estimate the volume or amount of wood in the tree. A tool, called a tree scale stick, was developed specifically for this purpose. Scale sticks are available at no cost from a Conservation Department forester or can be purchased from a forestry equipment dealer. The sticks have scales that measure the diameter and number of logs in the tree and estimate the volume of logs.

Tree diameter is measured on the main stem 4 1/2 feet above the ground. This is referred to as diameter at breast height, or DBH. Merchantable tree height is the height of the stem from the top of the stump to the upper limit of utilization for that tree.

The upper limit of utilization is where the main stem reaches a minimum usable top diameter, a main fork, a serious defect such as a hole or decay, or where excess limbs occur. The usual minimum top diameter for sawlogs is 8 inches and 4 inches for pulpwood. Estimating the number of sawlogs takes practice. In addition, a sawlog tree must meet the following specifications:

• Be a desirable species



4 feet

A board foot is the volume of wood in a board 1 inch thick by 1 foot wide by 1 foot long.

8 feet

4 feet

A standard cord is a stack of wood 4 feet high, 4 feet wide and 8 feet long.

- Have a minimum top diameter of 6 to 12 inches at the small end of the log
- Be at least 8 to 10 feet long
- Be generally free of large branches
- Be straight and free from crooks and sweep.
- Be generally free of major defects, such as rot, knots, seams and foreign objects, such as nails and wire.

It takes an experienced eye to detect damage from partially healed defects. Trees with minor defects are tallied during the cruise, and the total volume of the stand reduced proportionally to account for wood that is not merchantable due to defects. Trees that are not merchantable for sawlogs can sometimes be used for pulpwood or firewood. See Appendix 7 for detailed instructions on how to use a scale stick.

It is generally not practical to measure every tree in the stand. Instead, accurate measurements are made on a number of sample plots, and this information is expanded for the entire stand. Sampling is much more time efficient than doing a complete tally, and the results are often as accurate.

Plot sampling involves tallying every tree within sample plots in each stand. Generally 10 to 40 percent of the area of a stand is sampled. How much to sample may depend upon how accurate the tally needs to be. A cruise that will become the basis for a timber sale should be more accurate than one used to estimate young growing stock.

Appendix 8 describes how to conduct a fixed area plot cruise, how many plots to measure and what equipment you'll need. Appendix 9 shows how to set up a tally sheet to record the information you collect from the cruise and calculate the volume in the stand.

Using the inventory

Information collected during the inventory reveals the following three important features about a woodland:

- How well trees are growing on a particular site. This is done by measuring the site index of a stand.
- An accurate estimate of the volume of wood and the stocking density in each stand, which is tabulated on the tally sheet.
- Which tree species are most common in each stand, which is found on the tally sheet.

The above information can help the owner calculate the current and potential value of the woodland to determine when trees should be cut.

The site index, stocking density and potential value form the basis for determining which management activities are most appropriate.

Site index

Just as some farmland is better than others for growing crops, forest land varies in its ability to grow certain tree species. A tree's rate of growth at a specific location is its site index, and that figure is affected by the following variables:

- Tree species
- The soil's fertility, depth, texture and moisture-holding capacity
- Availability of water, determined by rainfall, soil drainage and aspect
- Forest pests present
- Shading by overstory
- Air characteristics, such as pollution, temperature, humidity and wind exposure.

It is difficult to analyze the effects of any one variable on tree growth. Instead, foresters use a simple system, called site index, to estimate the overall effects of these variables. The site index is based on the height to which each species grows in a fixed number of years. In Missouri, 50 years is used as the index age. Appendix 10 gives detailed instructions on how to measure the site index.

Site index provides an assessment of an area's ability to

grow trees and, thus, its timber-producing potential. An area with a low site index has less timber-producing potential and, therefore, does not warrant as much money, time and effort invested as an area with a higher index.

Site index charts or curves have several limitations and should be used with caution because:

- Small errors in age and height measurements can lead to relatively large errors in site index.
- Site index curves apply only to stands in which the trees are about the same age.
- Previous unknown cutting practices, insect attacks and diseases may have had a significant effect on the stand's growth.

Stocking density

Information from the tally sheet can be used to determine the stocking density of a stand. However, it is not possible to determine whether a stand is overstocked (containing too many trees for optimal growth) or understocked (containing too few) simply by counting the number of trees in each acre. Just as the number of plants that can grow and prosper in a flowerpot is affected by the size of the plants, the number of trees that can grow well in a forest depends upon the number and size of the trees.

Two following two factors must, therefore, be taken into account to determine whether a stand is adequately stocked:

- The average DBH
- The number of trees per acre.

See Appendix 12 for more details on finding a stand's stocking density.

The stocking guide also gives the stand's basal area, which is the cross-sectional area of all trees in the stand. This indicator of the degree of competition in a stand can be used to determine the number of trees to be removed to maintain optimal growth rates. Appendix 11 gives instructions on how to measure a stand's basal area.

Tree value

The timber value of individual trees varies greatly depending upon a number of factors. Trees that exhibit desirable characteristics or have good potential for developing desirable characteristics should be chosen as crop trees and favored in management decisions. Timber value is determined by:

- *Tree species*. The wood of different species varies greatly in strength, density, appearance, flexibility and durability. Such characteristics determine the suitability of specific woods for various uses and their potential value.
- *Defects and form*. Knots, rot and shake weaken the structural strength of veneer and lumber. Sweep and taper limit the amount of lumber that can be sawed from a log.
- *Size*. It is more efficient to work with large trees. Also, logs must be a minimum diameter to be used for sawtimber or veneer. Veneer logs have a larger minimum diameter than sawlogs, but veneer logs are often several times more valuable than comparably sized sawlogs.
- *Harvest and markets*. A tree's value is influenced by all of the following: the volume of the merchantable timber per acre, the distance the logs must be skidded and hauled to a mill, the topography of the sale area, the season of the year, the efficiency and skill of the loggers, and local log supply and demand.

When to harvest

As soon as a tree has enough wood fiber to meet the costs of logging, hauling and processing, it has a positive dollar value to the landowner and is merchantable. It is usually financially unwise to harvest trees as soon as they reach merchantable size, however, because they are not yet at their optimum value. Consider the following:

- At 12 to 14 inches DBH,

Uses of several common Missouri tree species

Tree Species	*Common Uses*
Shortleaf pine	construction lumber, boxes, millwork, pallets, ties, posts, poles
Eastern redcedar	closet linings, paneling, novelties, posts, animal bedding
Baldcypress	trim and molding, shingles, siding, posts, poles
Black walnut	furniture, veneer, gunstocks, paneling
Red oak	furniture, veneer, flooring, trim and molding, construction lumber, ties, pallets, pulpwood, charcoal
White oak	furniture, veneer, flooring, cooperage, trim and molding, construction lumber, ties, pallets, pulpwood, charcoal
Hickory	tool handles, athletic equipment, furniture, paneling, pulpwood, charcoal
Ash	baseball bats, athletic equipment, furniture, veneer, trim, tool handles
Cottonwood	boxes and crates, rough lumber, pulpwood, berry boxes
Sweetgum	veneer, furniture, lumber, paneling, boxes, ties, pallets
Sycamore	boxes and crates, furniture, pallets, ties
Yellow-poplar	furniture, trim and molding, boxes and crates

hardwoods have a low value, but the rate at which they are increasing in value is high, especially for fast-growing trees that have proper growing space.

- As a hardwood tree increases in diameter from 14 to 20 inches, it may double in merchantable height, increase more than three times in volume (from 79 to 295 board feet) and increase more than 13 times in dollar value (from $13 to $168). If a market exists for veneer, its value may be substantially more.
- At 14 to 20 inches DBH, hardwoods may nearly double in value for each 2 inches of diameter growth as log grade improves with size and as growth in height continues. At a growth rate of 2 inches in diameter every 10 years (10 growth rings per inch), a tree will nearly double in value in 10 years (a compound growth rate of 7 percent, not including inflation).
- At 20 to 24 inches DBH, hardwoods increase substantially in dollar value, but because the grade has peaked, the rate at which their value is increasing may slow to a compound growth rate of 3 percent or less. The increase in value is mostly due to the increase in volume.

High-quality 14- to 20-inch trees are merchantable, but not "financially" mature. They are

the true money makers in the woodland and should not be harvested during this prime growth period unless they are crowded.

The timber value of individual trees—regardless of species, logging costs and current markets—is largely a function of the volume of wood they contain and its quality. Log grade is determined by log diameter, length, form and defects.

In general, as a tree increases in size, its logs increase in grade. As grade and size increase, so does value. Diseased and low-vigor trees, on the other hand, may lose value and grade faster than they grow in volume. Therefore, harvests should occur when the rate of tree growth and value have peaked.

Recommended rotation lengths and diameter for oak sawtimber

*Site index**	*Rotation length in years*	*Rotation diameter in inches*
75+	60-75	24-28
55-74	75-90	20-24
40-54	90-120	16-18

**See Appendix 10 on page 91 for information on how to determine the site index.*

Forest Ecology

Shortleaf pine

Ecology is the study of the interrelationships between organisms and their environment. How trees grow and why they grow where they do are influenced by many factors, both living and non-living. Some of the biotic, or living factors, include other plants, animals and micro-organisms. Abiotic factors include climate, topography and soil. All of these factors are interconnected, and it is impossible to alter one factor without affecting the others. Forest ecological factors can be grouped into five broad categories:

- Physical environment
- Tree species characteristics
- Interrelations among trees and other plants
- Interrelations with animals
- Succession.

A well-managed forest can provide habitat for wildlife, as well as an income from wood.

Physical Environment

The forest physical environment includes climate, topography and soil. Directly affecting trees are sunlight, temperature, precipitation, soil characteristics and nutrients.

Through time, species have become adapted to the combinations of physical factors where they now naturally occur. The climate, which is the overall pattern of seasonal temperature and precipitation, determines the general forest type and species present.

Site characteristics that affect tree growth include soil depth, texture, moisture, fertility and topography. Generally, deep soils are better for tree growth than shallow soils because they potentially have a greater nutrient supply and water-holding capacity. Tree roots absorb nutrients and moisture in the top 2 feet of the soil. Tree growth will be affected where bedrock, coarse gravel, a hardpan layer or excessive moisture restrict rooting depth.

Soil texture refers to the size of the soil particles. Particles are classified by size as sand, silt or clay. Sand particles are relatively large, silt is moderate and clay is very small.

Different soils have different proportions of each particle size. For example:

- Soils with a high proportion of sand have large pore spaces between the particles. They tend to be dry because they absorb, as well as drain, water quickly.
- Clay soils have a high water-

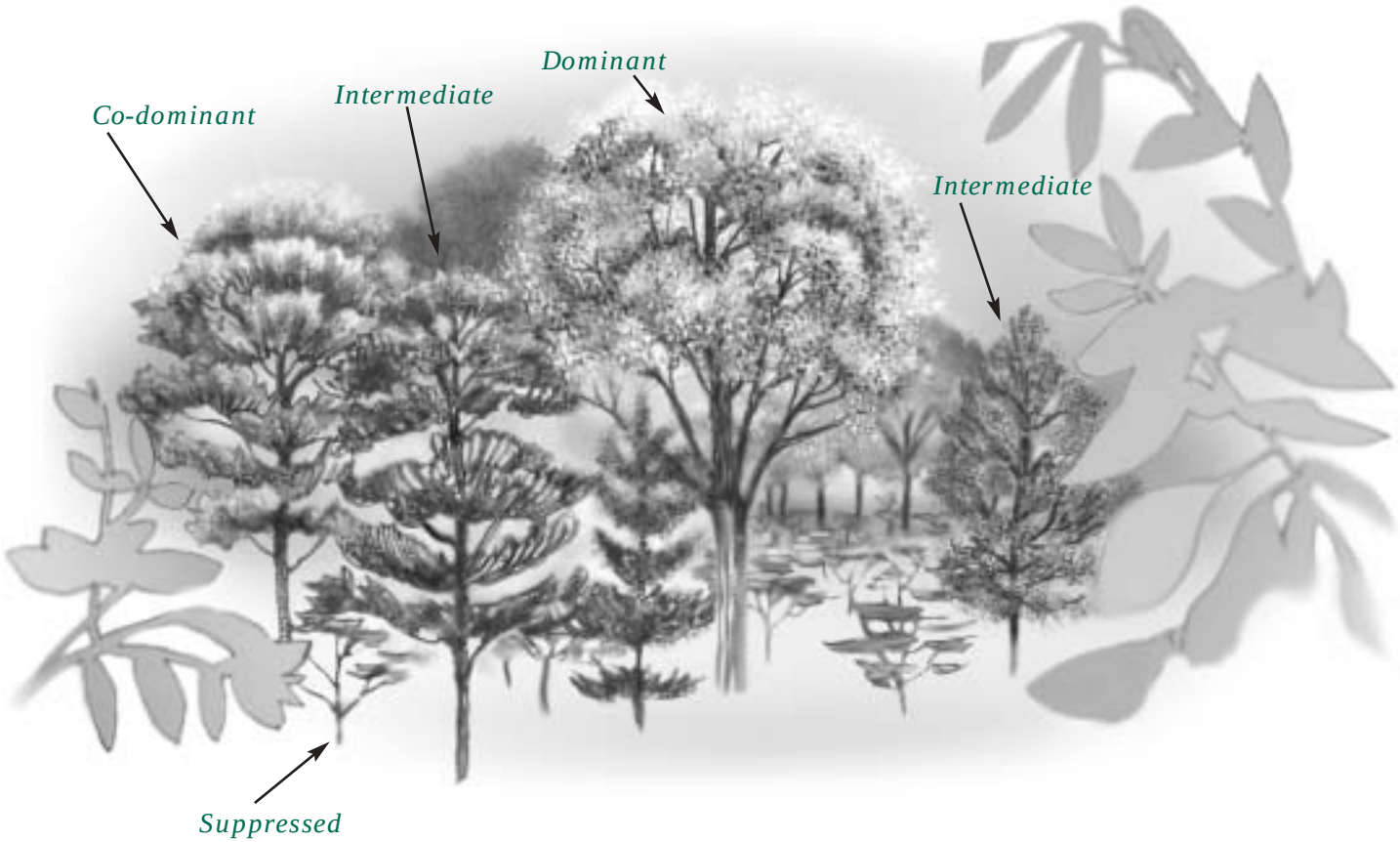
holding capacity, but they absorb water slowly. Also water adheres so tightly to the clay particles that much of it is unavailable to the plant.

- Soils with a high proportion of silt are most favorable for water absorption and holding capacity.

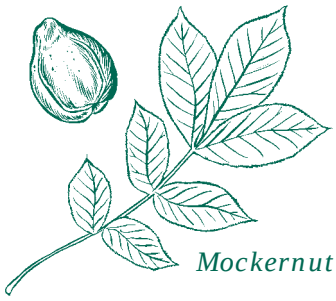
Soil fertility is based largely on the type of parent material from which the soil originated. Some of the most fertile soils originated from limestone, shale and windblown deposits. Some of the least fertile soils originated from sandstone and granite. Generally, clay and silt soils have a greater nutrient supply than sandy soils.

Topography affects tree growth because of its influence on soil depth and available moisture. Because gravity pulls soil particles and water downhill, soil depth, nutrient supply and available moisture are usually greater on bottomlands and lower slopes than steep slopes and ridge tops.

Aspect, which is the direction a slope faces, also influences the amount of sunlight and, consequently, soil moisture available to trees. North- and east-facing slopes tend to be cooler and moister than slopes



A tree's dominance refers to the position of its crown relative to other trees. Dominant trees have the largest crowns and are taller than most other trees in the stand. Co-dominant trees make up the general canopy level. Intermediate trees are slightly lower than the general canopy and have relatively small crowns. Suppressed trees are below the canopy and receive little sunlight.



Mockernut hickory

that face south and west. This is because the sun is slightly to the south in the northern hemisphere and shines more directly on south slopes. This results in a hotter, drier site.

West-facing slopes are drier than those that face east because the sun shines on west slopes during the hottest time of the day, increasing water use by trees and evaporation from the soil. These effects become exaggerated as the steepness of the slope increases. See chart below.

Tree species characteristics

Important tree species characteristics are seeding and germination habitats, growth rate, tolerance to shade, reaction to soil physical conditions, space requirements and response to release from competition. They also include length of life and size at maturity, resistance to damaging agents, interrelations with wildlife and the inherent variability of individuals within a tree species.

Shade tolerance, for example, is the ability of a tree species to grow in the shade of other trees. Species differ with respect to their tolerance for shade and competition. Knowledge of a species' tolerance is essential to the forest manager because trees must grow together in competition for sunlight and nutrients. Trees are classified on a scale from very tolerant to very intolerant. Those that are very tolerant will reproduce and grow beneath a dense canopy. Intolerant species will survive only if their seeds sprout in openings with full sunlight.

Each species has its own ecological niche in a given site and under the light conditions that are available. For example, in the Ozarks shortleaf pine outgrows most other species on dry, rocky south- and west-facing slopes when it receives full sunlight. But on deep, well-drained soils on north slopes, it can't compete with white or red oak. See chart on page 15.

Interrelations among trees and other plants

The interrelationship among trees is mainly concerned with competition for space, where they have adequate sunlight,

Effect of Site Characteristics on Tree Growth

	More favorable for tree growth	*Less favorable for tree growth*
Position	Broad ridges Lower slopes	Narrow ridges Upper slopes
Slope	Gentle slopes	Steep slopes
Aspect	North- and east-facing slopes	South- and west-facing slopes
Soils	Deep soil Fine textured Good drainage	Shallow soil Coarse textured Poor or excessive drainage

moisture and nutrients to grow. This factor is closely connected to species requirements and tolerance, which are discussed in the previous section.

All these interacting forces determine the density, species composition, size and age arrangement of trees in the forest. As a landowner, you may spend a considerable amount of time and money trying to modify these characteristics to maintain a healthy, vigorous forest.

Interrelations with animals

The interrelationships between forests and animals may not be so obvious, but they are real and, in some cases, critical. It is well known, for example, that squirrels and birds disseminate tree seed. A forest can be altered or damaged by overuse by animals, such as livestock. Under most conditions, the forest as a habitat is reasonably balanced with animal populations. But when the balance is upset, like with a deer population explosion, it has consequences on the forest. The habitat-animal balance should be maintained, and both the animal population and the habitat should be managed.

The forest, above and below ground, is an integrated community. Micro-organisms and fungi are a natural part of forest soils. They contribute to fertility and break down organic matter into soil material. Any drastic forest disturbance usually changes the soil micro-plant and animal life temporarily.

Succession

Succession is the gradual replacement of one community of plants by another. Natural succession of vegetation is what happens over many years in an abandoned crop field, after a hot wildfire or other disturbance. The progression of vegetation is determined by the climate, the remaining soil and any residual plants.

After a disturbance, forests progress over many years through pioneer species, such as blackberry, sassafras and persimmon, to species, such as oak and hickory. This succession takes place because the pioneer species are much better adapted to the bare soil. Their presence changes the site conditions so the more permanent species can thrive and occupy the area.

It is difficult to maintain pioneer species for long periods of time, although in some forest types the pioneer species are more valuable than the succeeding species. In these cases, forest management practices imitate disturbances to slow succession and maintain the desired species. For these practices to be effective, you must have a good knowledge of each species' ecological requirements.

River birch

Characteristics of Important Missouri Trees

Species	Growth rate *	Soil moisture	Shade tolerance	Flood tolerance
Ash, green	Fast	Wide range	Intermediate	Tolerant
Ash, white	Medium	Average	Intermediate	Intermediate
Baldcypress	Medium	Moist to wet	Intermediate	Tolerant
Basswood, American	Medium	Moist	Tolerant	Intolerant
Beech, American	Slow	Moist	Very tolerant	Intolerant
Birch, river	Medium to fast	Moist	Intolerant	Tolerant
Blackgum	Slow	Wide range	Intolerant	Intermediate
Buckeye	Slow	Moist to average	Tolerant	Intermediate
Cottonwood, eastern	Fast	Wet to moist	Very intolerant	Tolerant
Dogwood, flowering	Slow	Moist to average	Very tolerant	Intolerant
Hackberry	Medium to fast	Wide range	Intermediate	Intermediate
Hickory	Slow	Average	Intolerant	Intolerant
Maple, silver	Fast	Wide range	Tolerant	Tolerant
Maple, sugar	Slow	Moist to average	Very tolerant	Intolerant
Oak, red	Medium	Average	Intermediate	Intolerant
Oak, white	Slow	Average	Intermediate	Intolerant
Pecan	Slow	Moist	Intolerant	Intermediate
Pine, shortleaf	Fast	Dry	Intolerant	Intolerant
Redcedar, eastern	Medium	Average	Intolerant	Intolerant
Sassafras	Medium	Wide range	Intolerant	Intolerant
Sweetgum	Medium	Moist	Intolerant	Tolerant
Sycamore	Fast	Moist	Intolerant	Intermediate
Walnut	Medium	Moist to average	Intolerant	Intermediate
Willow	Fast	Wet to moist	Very intolerant	Tolerant
Yellow-poplar	Fast	Moist	Intolerant	Intolerant

** Growth Rate: Slow = less than 12 inches of growth annually*
Medium = 12-24 inches of growth annually
Fast = more than 24 inches of growth annually

Silvicultural Systems

Simply stated, silviculture is the producing, growing and tending of a forest. (*Silva* is Latin for forest.) Silviculture takes what foresters know about how trees grow and interact with their environment—forest ecology—and applies that to produce a forest that best meets the objectives of the landowner. It is concerned with the technical details of growing a forest.

The main, but not the only, treatments making up these forest-regenerating systems involve the cutting of trees. Cuttings can be divided into two types:

- Regeneration cuttings to help reproduce a forest
- Intermediate cuttings in immature stands to maintain vigor, growth rates and species composition.

Regeneration cuttings have such a great influence on the character of the new stand that silvicultural systems are named after them. The major systems are clearcutting, seed-tree, shelterwood, single-tree selection and group selection. Each system controls the amount of sunlight that reaches the forest floor, and therefore influences the type of forest that develops.

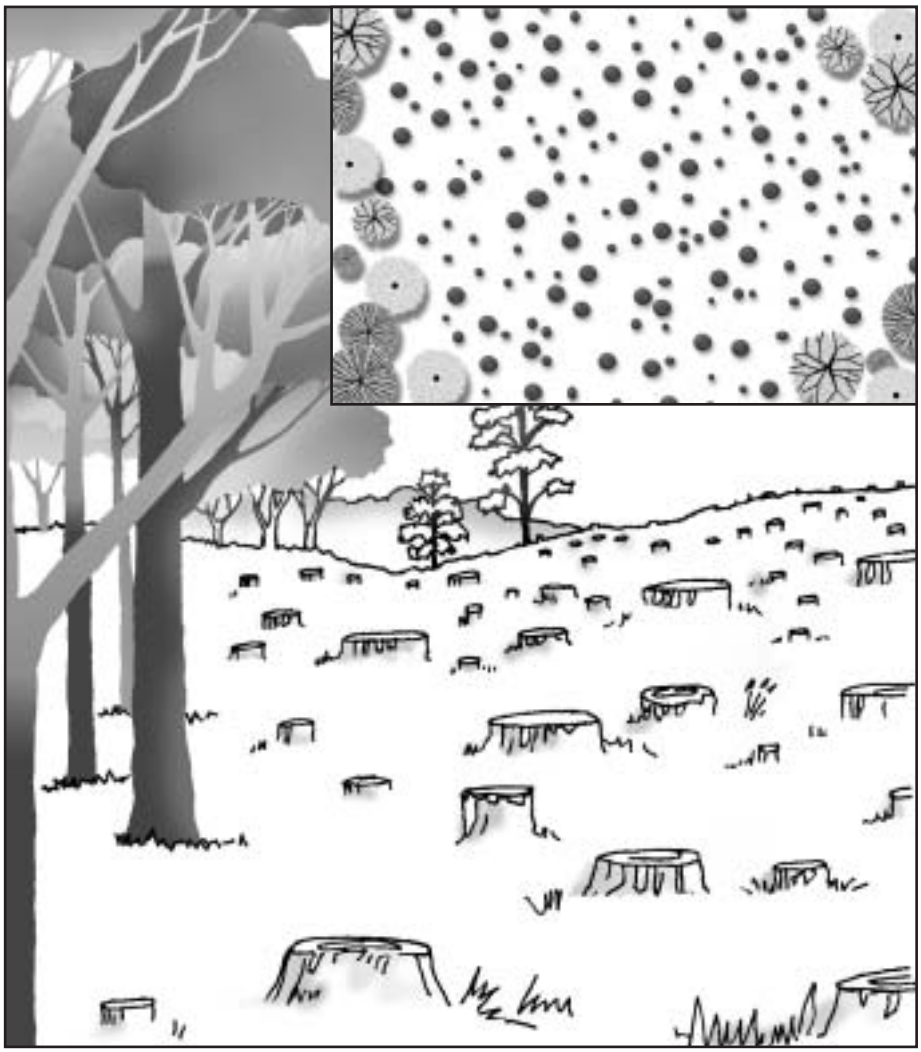
The system you use depends on the following:

- Your objectives, such as timber, wildlife or aesthetics
- Maintaining the species in the present stand
- Ecological requirements of the desired species
- Whether you want to create an even- or uneven-aged stand
- Economics
- Site conditions.

Clearcutting, seed-tree and shelterwood result in even-aged forests, single-tree and group selection in uneven-aged forests.

Clearcutting system

Clearcutting removes all trees in the stand in one operation. The new stand develops from advance regeneration, new seedlings and stump sprouts. Clearcutting is often confused with practices that convert land to some other use. Land conversion results in a pasture, housing development or mall. Clearcutting, however, results in a new forest.



Clearcutting removes all the trees in the stand and is used when an even-aged forest is the objective. See overhead view, above right.

Clearcuts should be at least 2 acres in size to minimize edge-shading from adjacent stands. Harvest all merchantable trees. All trees greater than 2 inches DBH should then be felled or deadened except those trees left as wildlife dens and snags and trees along riparian buffers.

Clearcutting is the most unsightly of the silvicultural systems. Arrange and shape clearcuts so they mingle with uncut stands and blend into the landscape as much as possible. For more tips, see the chapter on aesthetics on page 50.

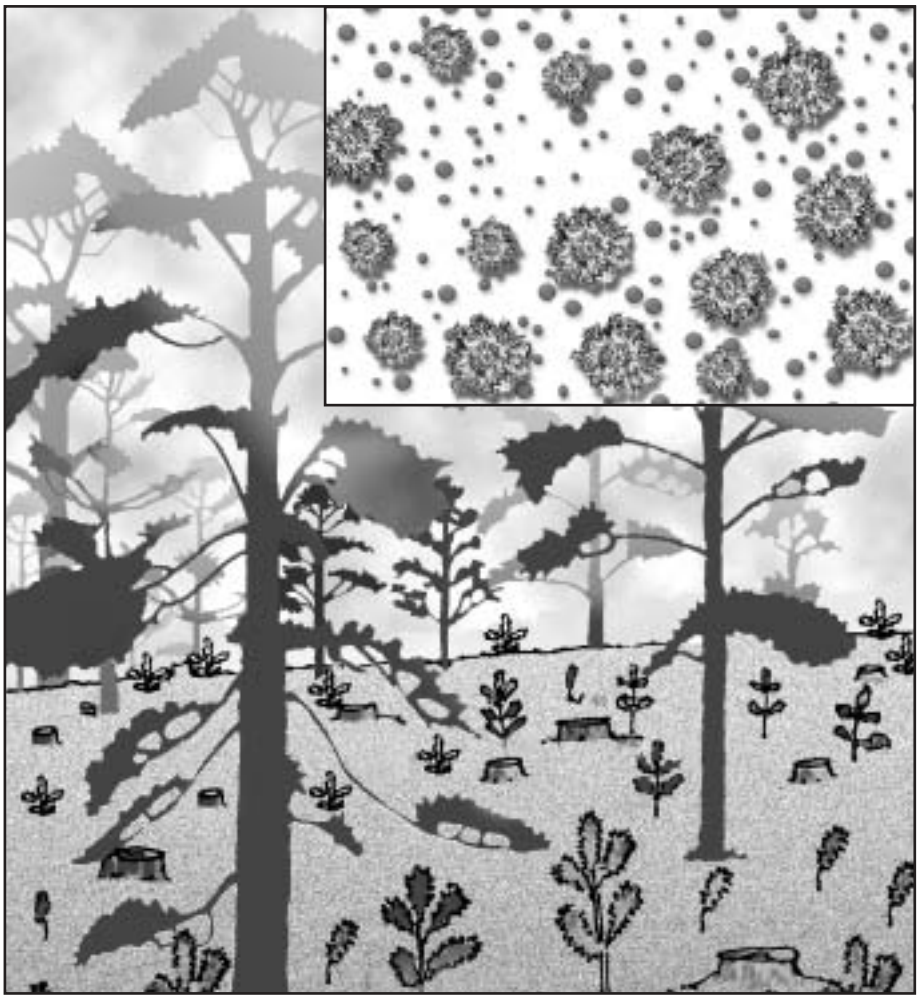
Clearcutting may be appropriate in the following situations:

- To regenerate species that need full sunlight for seed germination and seedling development
- To regenerate shallow-rooted species or trees growing in exposed locations where trees left standing after a partial cut might be uprooted or damaged by wind
- To produce even-aged stands
- When the entire stand is overmature and needs to be regenerated
- To salvage trees that have been killed by fire, insects, disease or wind
- When you want to convert the stand to a different species
- To provide habitat for wildlife that requires high-density, even-aged stands.

Seed-tree system

The seed-tree system leaves trees scattered throughout the area to provide seed for the next stand. Once the new seedlings are established, the seed trees may be harvested or left to grow until the next regeneration cut. The seed-tree method will only work with light-seeded species. In Missouri, it has been used to regenerate shortleaf pine.

Seed trees should be healthy, large crowned and wind firm. Trees are usually left singly, but may be left in small groups for wind protection. Look for good seed producers by the presence of old cones in the crowns. Leave about 10-15 well-distributed seed trees per acre. To regenerate pine, you will need to kill unwanted hardwoods in the understory and prepare a seedbed by prescribed burning or by scarifying the soil.



The seed-tree system leaves trees scattered throughout the area to provide seeds for the next stand. See overhead view, above right.

Some disadvantages of the seed-tree method are listed below:

- Seed trees may be killed or damaged by wind, fire or pests before they produce seed.
- It may not be economical to harvest the seed trees after regeneration is established.
- The harvest of seed trees will likely damage new seedlings.
- There could be a long delay in seed crops and subsequent invasion of competing vegetation.
- There is little control over spacing and stocking rate of the regeneration.

Shelterwood method

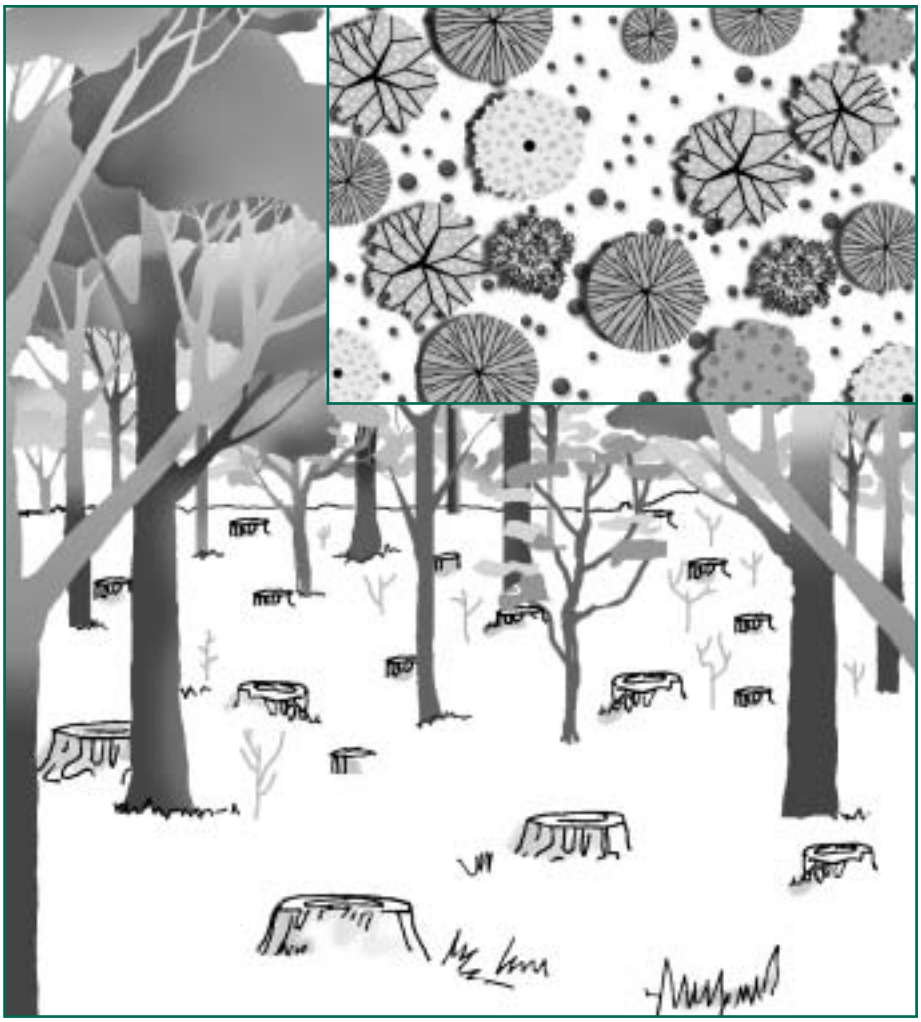
The shelterwood method is similar to the seed-tree method, but more trees are left and the new stand is established under the partial shade of the older trees. The overstory is then removed to release the regeneration. Two cuttings are commonly made, but occasionally three harvests are necessary.

In a three-cut system, the first harvest is called a preparatory cut. It leaves the best trees with plenty of growing room to expand their crowns and produce seed. The overstory should be reduced to about 70 percent stocking. It removes defective, mature and undesirable species. This cut can be eliminated if intermediate thinnings have accomplished the same results.

The second cut, called the seed cut, is made several years later when there is a good seed crop. The seed cut allows more sunlight to reach the forest floor, stimulating new seedling growth. About 30 to 60 percent of the stocking is removed in this cut. Cutting and skidding of logs bares mineral soil, preparing the site for seed germination. It may take five to 20 years for oak seedlings to become established and reach a size where they can compete successfully.

The final cut removes the remaining mature trees, releasing the young stand. This cut must be made soon enough to maintain the even-aged characteristic of the new stand or a two-aged stand will develop.

The shelterwood system is used to establish advance regeneration before a final harvest. It is most appropriate where: 1) the species



In the shelterwood method, a new stand is established under the partial shade of older trees. See overhead view, above right.

to be regenerated can grow under partial shade; 2) seed trees are not subject to windthrow, wind damage, epicormic branching or logging damage; and 3) the increased cost of several partial cuts is acceptable. Since a seedling stand is present when the final cut is made, shelterwood is more aesthetically pleasing than clearcutting.

Single-tree selection system

Unlike the three systems described above, the single-tree selection system creates and maintains an uneven-aged stand. Each tree is evaluated independently from the others in the stand. Individual trees are harvested as they mature. Seedlings and sprouts grow up in the spaces created when mature trees are removed.

Periodic harvesting and regeneration results in a stand that contains trees of many ages and sizes. Because relatively few trees are harvested at any one time and because the forest floor is generally shaded, this system favors species that are shade tolerant.

Too often the single-tree selection system is improperly used, and stands are high-graded. High-grading refers to harvesting only large diameter, high quality trees of merchantable species while leaving trees that are not salable because of small size, poor quality or undesirable species. Inferior trees, often with poor genetic characteristics, then make up the next stand.

In the single-tree selection method, individual trees are harvested as they mature, allowing seedlings to grow up in the newly created spaces. See overhead view, above right.

The single-tree selection system will not reproduce many oaks and hickories. It reduces the population of oaks and hickories and encourages shade-tolerant species, such as red and sugar maple, hornbeam and dogwood. Where young oaks and hickories are present, they will not develop properly under the crown closure maintained by single-tree selection. Even though large trees are periodically removed, the crowns are essentially closed. Oak regeneration will continue to die back rather than growing into a sapling.

Single-tree selection may hurt some wildlife species because nut production declines when oaks and hickories are harvested and replaced by other species. Forage

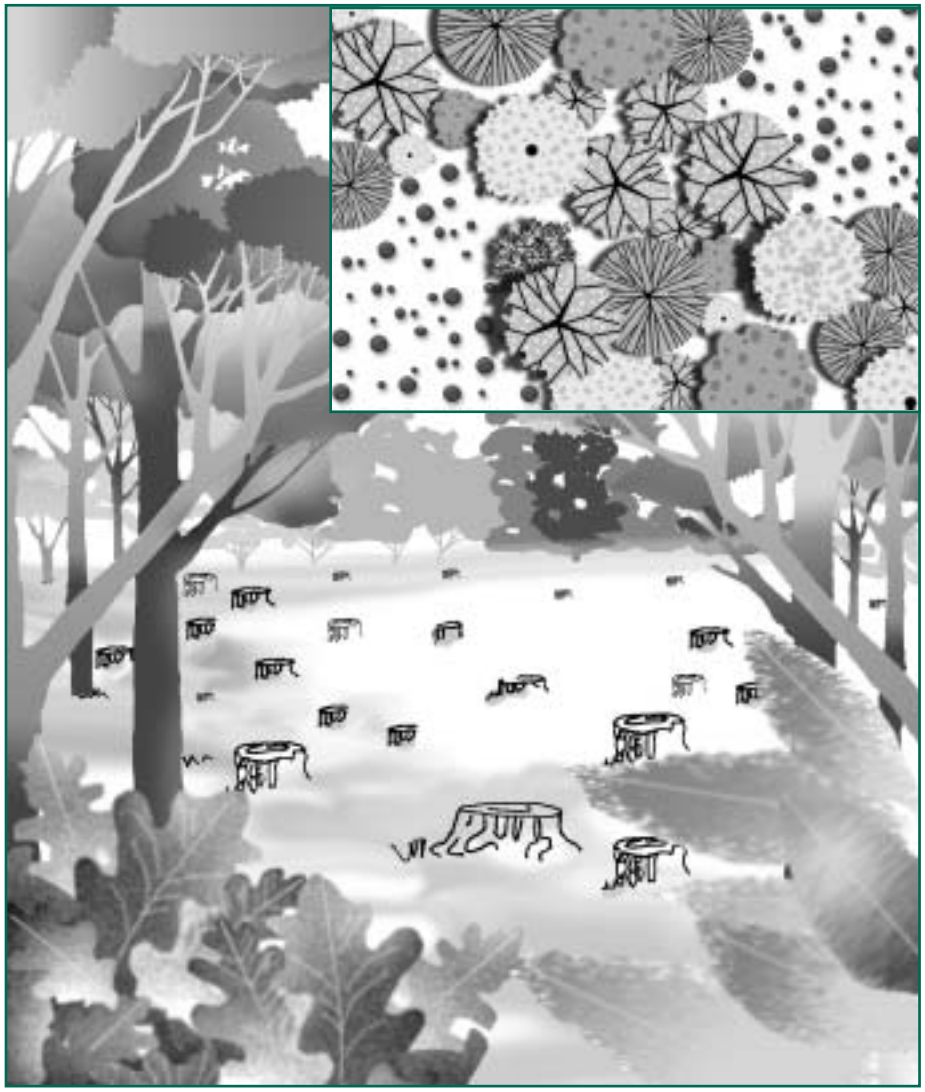
and browse are scant under the nearly complete crown cover, and edge habitat that is important to many wildlife species is not present.

Group selection system

The group selection system harvests small groups rather than individual trees. The openings resemble miniature clearcuts, but the major difference is that the resulting regeneration occupies too small an area to be considered an even-aged stand. As in the single-tree system, thinning and harvesting cuttings are done at the same time. The new trees that come up in these small openings are regarded as parts of a larger stand that contains trees of many ages. In either selection system, frequent harvests are needed to maintain a proper balance of tree ages and sizes.

Oaks and hickories can be regenerated using group selection. Oaks will grow best near the center of openings where they receive more sunlight. Openings will vary in size from about 1/10 acre to 1/2 acre based on surrounding tree heights, slope and aspect.

Group selection is more difficult to apply than other silvicultural systems. Trees of all sizes should be in the stand at all times. When harvesting, trees over the entire range of size classes must be removed to maintain an uneven-aged stand. In addition, the small group openings must be located to take advantage of advance regeneration, pockets of merchantable or dying trees or to provide special wildlife benefits. It is usually a good idea to get assistance from a forester before implementing a group selection cut.



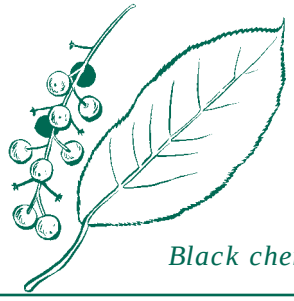
The group selection system havests small groups of trees resembling miniature clearcuts, which produces excellent wildlife habitat. See overhead view, above right.

If openings are kept small and well scattered, group selection maintains aesthetic qualities of an unbroken forest. It is well suited to small woodlots where occasional cuts are desired, but where regular harvests are immaterial. The system produces excellent wildlife habitat, including openings with abundant forage and browse, a large amount of edge and many mast-producing trees.

Management Choices for Missouri Forests

Silvicultural System	*Timber Considerations*	*Wildlife Considerations*
Even-aged Management *Clearcut* *Seed-tree* *Shelterwood*	• Preferred method to establish shade-intolerant tree species such as oak, hickory and pine. • Adequate advance regeneration or desirable seed trees must be present. • The new stand of trees is all about the same age and size. • Clearcut and seed-tree minimize logging damage to remaining trees. • Timber sale income is received in a relatively short time. • Visual effects of clearcut and seed-tree generally are not as pleasing. • Stands are easily identified, and management work is less complex and costly. • Usually the most cost-effective method of managing large tracts.	• Regeneration cuts mixed with stands of different ages and sizes create a diverse habitat for a wide variety of wildlife species. • Regenerates mast-producing trees important as food to many birds and animals. • Encourages a lush growth of vegetation preferred by many species. • Fruiting trees, den trees and snags can be marked to leave for wildlife.
Uneven-aged Management *Single-tree selection* *Group selection*	• Single-tree selection tends to encourage the development of shade-tolerant tree species such as sugar maple, elm and dogwood. • Creates forests with three or more different sizes and ages of trees. • Provides regular income from timber sales. • Maintains continuous forest cover at all times. • Management work is more complex and costs are greater. • Visual effects are generally more pleasing. • There is greater logging damage to the remaining trees. • Usually the preferred method for managing small tracts.	• On small tracts, a mix of shade tolerant and intolerant trees and shrubs can be created within the same stand. • Provides habitat for birds and animals preferring continuous forest cover. • Understory, midstory and overstory vegetation are all present in one stand. • Can select fruiting trees, den trees and snags to leave for wildlife. • Supplies food and cover for a wide variety of wildlife.

Regenerating Woodland Stands



Black cherry

Natural regeneration

Natural regeneration relies on new seedlings, stump sprouts and advance regeneration to establish a new forest stand. All hardwoods sprout, and stump sprouts can become well-formed stems in new stands. However, as trees grow old, the probability of stump sprouts declines. In Missouri if you want to regenerate hardwoods and if the potential for sprouts is low, advance regeneration must be present before the overstory of the present stand is heavily cut.

Advance regeneration is usually present in mature hardwood stands. If the stand has not been disturbed for several decades, the regeneration is probably small and not capable of competing successfully when the overstory is removed. For most species, the larger the advance regeneration, the better its chance of becoming dominant in the next stand.

Thinnings sometimes allow large advance regeneration to develop. Often, thinnings only allow shade-tolerant midstory trees to expand their crowns with little or no new advance regeneration. Thinnings, by definition, are not regeneration cuts and should not be relied upon to provide large advance regeneration.

If advance regeneration is inadequate and the stand is 10 to 20 years from being harvested, use the shelterwood method to develop the advance regeneration needed. One or more shelterwood preparatory cuts will be needed to reduce the overstory density enough for seedling growth. Herbicide control of undesirable species and seedbed preparation also may be necessary.

Artificial regeneration

Artificial regeneration is needed when advance regeneration has failed, a change in species is desired or the objective is to reforest open land. In addition, this method is a way to introduce genetically superior species to an area. Artificial regeneration involves either direct seeding or planting nursery-grown seedlings to establish a new forest stand. It speeds up the restocking of a stand, but is more expensive than natural regeneration.

Direct seeding

Direct seeding can be used to reforest large areas quickly on sites that are difficult to plant because of terrain or obstacles. It also can be used to establish species that are hard to start from a transplanted seedling. Labor and equipment costs are cheaper with direct seeding, but finding seed may not be easy and is usually expensive.

Success of direct-seeding projects depends on the control of seed-eating animals and a favorable seedbed. Almost any site capable of growing a forest also supports a population of small mammals and birds. Animals will venture into an opening to feed only if there is enough cover to protect them from predators. Site preparation to reduce the amount of cover helps reduce seed predation and improves germination. Chemical repellants also are available to treat the seed before planting.

Most seeds require contact with bare mineral soil for germination. To provide a favorable seedbed, do a prescribed burn, disk or otherwise scarify the area. This amount of soil disturbance may not be appropriate on steep slopes and on highly erodible soils. In these situations, use another planting method.

The best time to seed is in late fall or winter. The seeds of most forest trees need to go through several months of cold, called stratification, before they will break dormancy. If seeded too late in the spring, they may not germinate until the following year. Some species, however, may not remain viable for that long. Seed may be broadcast or spot seeded. Consult with your local forester on rates to use.

Planting seedlings

Planning for tree planting on your property should start well before you order seedlings. A successful

planting job requires good planting stock, a properly prepared site, tree species matched to the site and soils, proper planting methods and adequate protection and care after planting. If you need assistance in planning a large plantation, contact your local forester.

Site preparation

Site preparation is an extremely important step in a successful planting project. You wouldn't think of planting your garden without tilling and preparing the soil. The same applies to planting trees. Remove any competing weeds that will rob new seedlings of moisture and nutrients so the newly planted trees will have a better chance of survival.

The two methods of site preparation are mechanical and chemical. Mechanical site preparation involves physically removing the competing vegetation from the planting site. For small plantings, scalp the sod and weeds from a spot 2 feet in diameter where each tree is to be planted. For larger plantings, plow or disk 2 to 3 foot wide strips where the tree rows will be planted. Leaving vegetation between the tree rows will help prevent soil erosion.

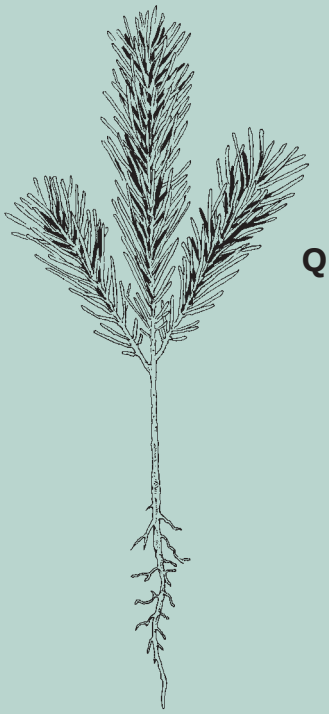
Chemical site preparation consists of using herbicides to control competing vegetation. Usually the herbicide is sprayed in a spot treatment around each individual seedling or in strips where the tree rows will be planted. There are many different herbicides with many different characteristics. Contact your local forester or University Outreach and Extension office for the latest recommendations, and always follow label directions.

Seedling selection

Because a seedling obtains moisture and nutrients from the soil, it is important to match the species to the type of soil on your

How to Space Seedlings

When planting seedlings, consider the height and spread to which they will eventually grow and the primary use of the planting. As a general rule, seedlings should be spaced as shown below:



Purpose	Spacing
Erosion control	3-6 feet
Reforestation	8-12 feet
Wildlife shrubs	3-6 feet
Windbreaks	5-12 feet

Quantity of seedlings needed per acre

Spacing	*Seedlings per acre*
3 x 3 feet	4,840
4 x 4 feet	2,722
5 x 5 feet	1,742
6 x 6 feet	1,210
7 x 7 feet	889
8 x 8 feet	681
9 x 9 feet	538
10 x 10 feet	436
12 x 12 feet	302
15 x 15 feet	194

For specific recommendations on spacing for your purpose and species selection, contact your local forester.

property. Some species, such as silver maple and cottonwood, prefer wet soils, while shortleaf pine grows best on drier soils. Most trees have a tolerance for a range of soils, but they will make their best growth on the soil types for which they are suited.

The amount of sunlight the seedling will receive also should be considered. Most trees prefer full sunlight, so planting trees in old fields is an ideal situation. Other species, such as flowering dogwood and downy serviceberry, need shade and will likely die if planted in full sunlight.

When to order

Applications to order trees and shrubs from the state forest nursery are usually available in mid-November for delivery the following spring. Orders are filled on a first-come first-served basis, so it is a good idea to order early for the best selection. Order forms may be obtained by contacting Conservation Department or University Outreach and Extension offices.

Tips on seedling care

During transportation

- Haul in a refrigerated truck if possible.
- Cover bundles with a tarpaulin to avoid excessive exposure to sun and wind.
- Stack seedling bundles with adequate ventilation to prevent overheating.
- Keep the transit period as short as possible unless refrigeration is available.
- Unload seedlings immediately upon arrival at destination and store properly.

During storage

- If possible, place seedlings in cold storage (33-40^{o} F); otherwise, place in a cool, shaded place. Protect seedlings from freezing.
- Tape up holes torn in packaging to prevent drying of roots.
- Pour cold water into the open end of the bundles often enough to keep seedling roots moist, but not wet.
- Stack bundles loosely, and use spacers between bundles to permit adequate ventilation.
- Stack bundles with one end higher than the other to permit drainage.
- If seedlings must be stored more than two weeks, “heel-in” seedlings in a trench located in a shaded, protected area.

During planting

- Avoid planting when the ground is frozen or extremely dry, or when excessively wet and sticky.
- Never leave open bundles of seedlings exposed to the sun and wind. During planting, take only a few bundles at a time. Cover the others, and keep cool and moist.
- Seedlings should be carried in buckets or bags and covered with wet moss to protect roots from exposure to sun and air.
- Remove only one seedling at a time from the bucket and plant immediately.
- Check spacing periodically to ensure proper number of seedlings per acre.
- When machine planting, match the tractor speed to the capabilities of the person planting.
- Check furrow depth when machine planting or depth of the planting hole when hand planting to provide for the full length of the roots when they are straightened.
- To check firmness of soil packing, grasp the top of the seedling and pull gently upward. If the tree pulls out of the ground easily, it was not firmly packed.

Tips for hand planting

- Plant trees as soon as possible after receiving them.
- Carry seedlings in a bucket half full of water or wet packing material such as moss. Don’t allow seedling roots to dry out. Do not store trees with their roots in water.
- Dig holes as deep as the root systems.
- Plant the seedlings at the same

depth they grew at the nursery or slightly deeper.

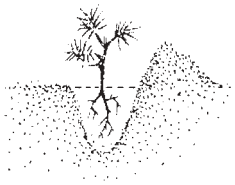
- Make sure the roots are spread out and are not bent or crowded.
- Pack the soil firmly around the roots to close air pockets.

Tips for machine planting

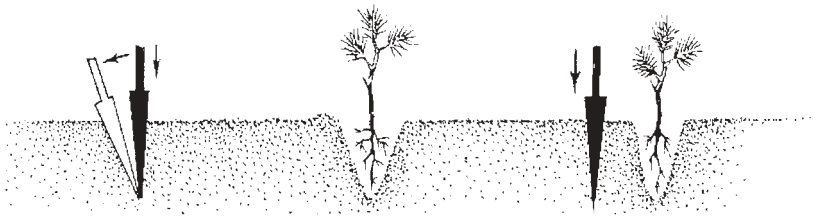
- Use a three- or four-person crew. One person follows the tree planting machine to straighten and pack poorly planted trees. Another keeps seedlings protected, separated and ready to load into planting machine trays.
- Trees in planting trays should be kept covered with wet moss. If roots are exposed to the sun and wind, the trees may be dead before they are planted.
- Run the machine deep enough to allow the roots to hang down straight in the planting trench,

Correct depth to plant a seedling

Look for the soil line on the seedling, then plant at the same depth or 1/2 inch deeper than the tree grew at the nursery.



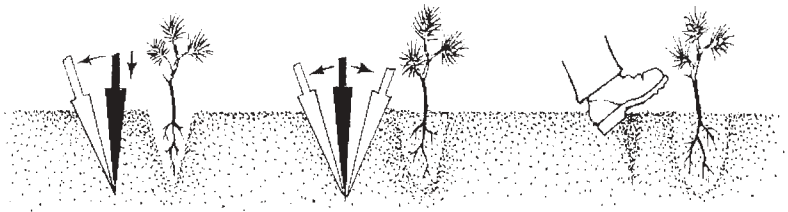
Hand Planting with a Bar



Insert dibble straight down as shown. Pull backward to open up the hole.

Remove dibble and place seedling at the correct depth.

Insert dibble straight down behind the last hole.

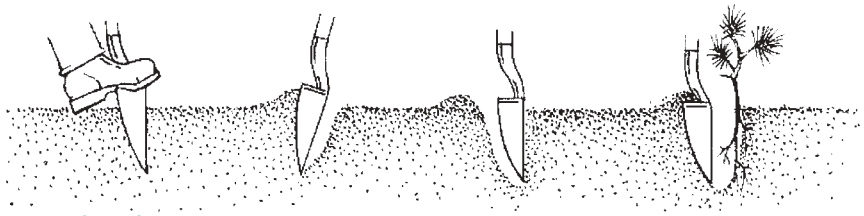


Pull dibble backward, closing the bottom of the slit.

Push forward and backward packing soil firmly against the root.

Fill in the last hole by firming with your heel.

Hand Planting with a Shovel



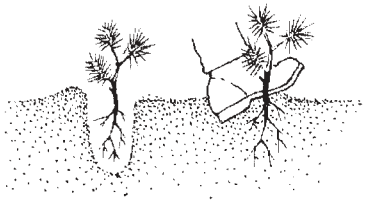
Insert shovel with the blade reversed and perpendicular.

Push the handle toward you to open up the bottom of the hole and to pull the dirt out.

Make a second cut to straighten the back half of the hole.

Pull the shovel toward you to make a clean hole. Place the tree in the hole, with the roots in a normal position.

Place soil in the bottom half of the hole. Pack with your heel.



Finish filling the hole with soil and pack down. Cover surface with mulch.

typically 8 to 10 inches. If the soil is too rocky or hard to permit machine planting, plant by hand.

- Set seedlings at the same depth or slightly deeper than they grew in the seed bed.

Care after planting

After establishing a new plantation, take the following precautions to protect your investment of time, money and effort.

- Besides killing trees outright, fires can leave scars inviting decay. Plow or disk a fire break around your plantation and maintain it during fire season.
- Livestock grazing probably destroys more trees in Missouri than fire. Livestock will eat young seedlings and trample the protective soil and leaf cover, encouraging soil erosion. Fence livestock from your woods and tree plantations.
- Animals, such as rabbits, mice and deer, can damage young trees. Keep the grass and weeds mowed short to permit easier hunting of rodents by hawks, owls and foxes. If deer damage is a problem, consider opening the area to hunting. Specially designed electric fences are effective, but can be expensive.
- Prevent a rank growth of weeds and grasses around new trees by cultivating, using herbicides, disking or hoeing as often as necessary during the first three to five years. Weed competition inhibits tree growth.
- Inspect plantations regularly for evidence of insect or disease damage. If excessive damage is found, contact your local forester for help in diagnosing the problem and to recommend controls.

Forest Improvement Practices

Bur oak

After a new stand of trees is established, a long period of time follows during which the stand grows and passes through different stages until it is mature and ready to be harvested, and then replaced by a succeeding generation. Cuttings made in the stand during its development from the regeneration stage to maturity are called intermediate cuttings.

The objective of intermediate cuttings is to improve the existing stand by regulating growth and concentrating that growth on the most desirable trees.

Intermediate cuttings can be distinguished from regeneration cuttings by their purpose. Regeneration cuttings create a new stand, and intermediate cuttings culture an existing stand. Most, though not all, intermediate cuttings are thinnings made to remove trees that crowd or restrict the growth of better trees. See page 33 on how to prune and below for how to do intermediate cuttings in sapling and pole stands.

Sapling stands

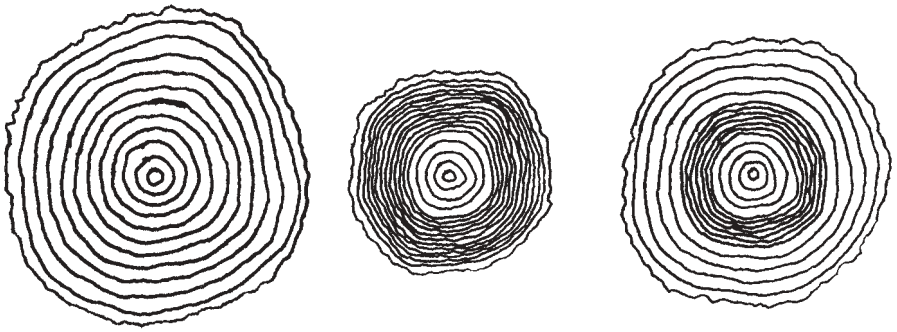
In sapling stands, most of the trees average less than 5 inches DBH. Any silvicultural work at this stage of the stand's life is non-commercial, so it must help improve the future crop trees to make the investment pay off.

Crop tree release is the best treatment for sapling stands. It is the selection and release of individual trees by eliminating trees that compete or will compete with the crop tree. Crop tree release can be used in any of the forest types found in Missouri.

Crop tree release guidelines

1. Select crop trees that are dominant or co-dominant in the canopy; free from crooks, forks, seams and pests; and are a valuable species.
2. Select stump sprouts as crop trees if they meet the previous criteria and originate at or below the groundline of the stump. Select only one or two crop trees per stump and cut all others. Two crop trees can be left on the same stump only if they are widely spaced with a U-shaped connection.
3. Wait until co-dominant trees in the stand average at least 25 feet tall (10 to 20 years) before releasing.
4. Release 50 to 100 crop trees per acre. Spacing for 100 crop trees per acre is about 21 by 21 feet and about 30 by 30 feet for 50 per acre.
5. Remove trees adjacent to the crop tree so its crown is free to grow on all sides.
6. Do not leave groups of more than two individual crop trees. Two crop trees can be left close to each other provided both have the potential to grow to sawlog size.
7. In oak-pine stands, both hardwood and pine can be

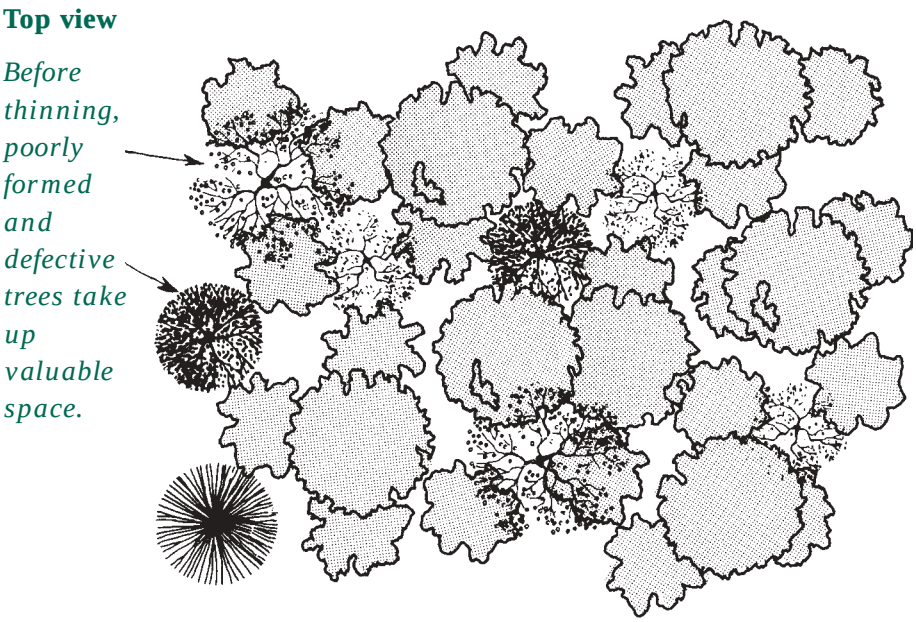
Thinning pays



Thinning brings results in a crowded forest. The tree on the left was grown under ideal spacing conditions. The tree in the middle was grown in a crowded stand. On the right is a tree that was crowded, then thinned.

released if both species fit into the management objectives.

8. Generally, do not release crop trees in sapling stands where poletimber thinnings are economical. Let the stand grow and use a commercial thinning to remove small products such as posts or pulpwood.



Pole stands

Timber stand improvement, or TSI, is the general term used for any thinning in pole-sized stands. The purpose of TSI is to free desirable trees from competition, thin the trees to desirable numbers and remove the poorer trees. This improves the overall condition of the stand, and wood growth is concentrated on a number of selected trees.

A stand of trees that averages 5 to 10 inches DBH is a prime candidate for thinning because this size tree responds rapidly after thinning. This does not mean that stands averaging more than 12 inches in diameter cannot be thinned, but these trees do not respond as quickly after thinning as the smaller trees. The larger trees are approaching commercial size, and care should be taken not to deaden or cut trees for firewood that will produce quality saw logs.

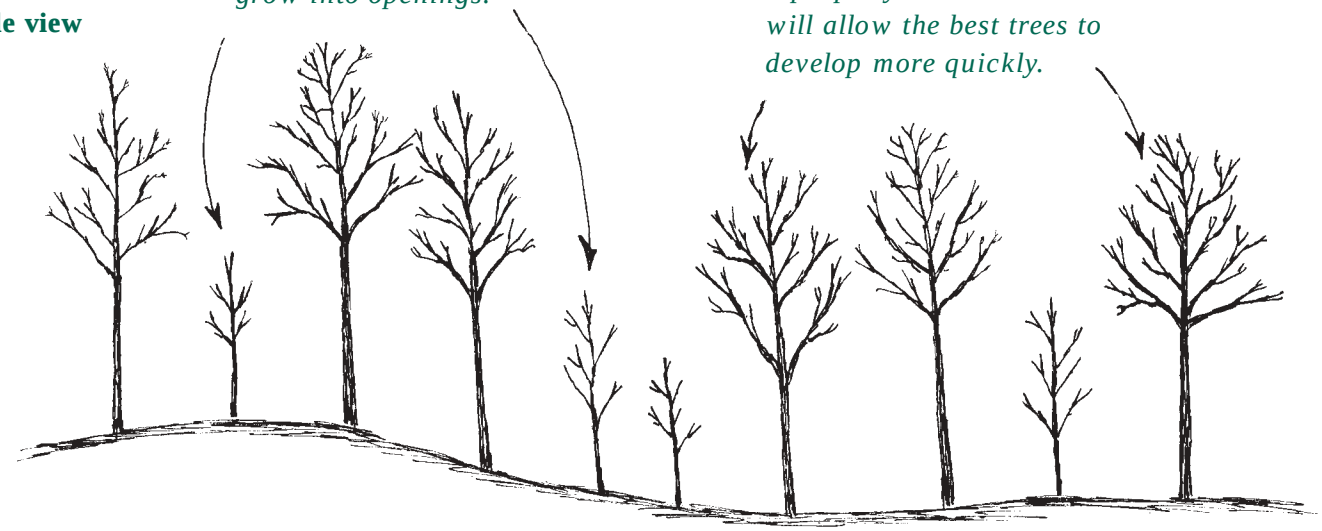
Choke cherry

After thinning

Side view

Young, vigorous trees will grow into openings.

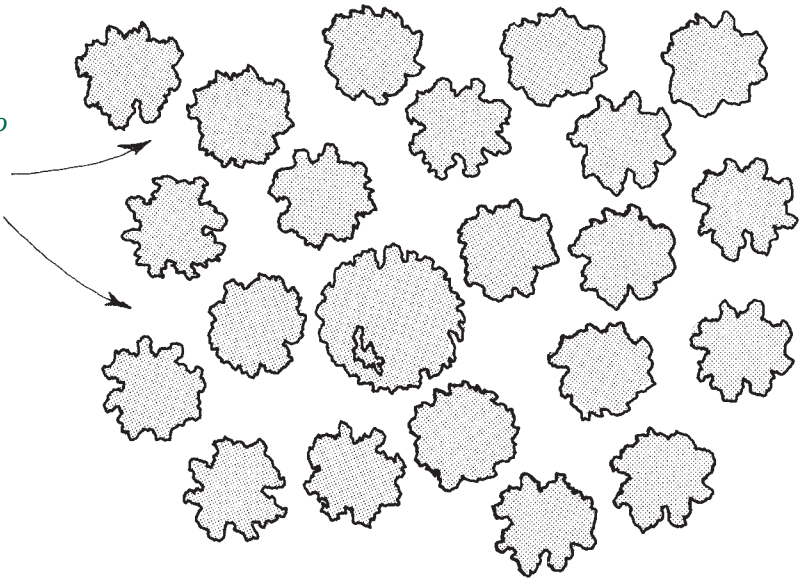
A properly thinned stand will allow the best trees to develop more quickly.



There are several benefits to thinning the larger-sized stands. First, the cull trees and undesirable species can be cut for firewood. Cull trees are those that are not marketable now and are not expected to become marketable in the future. After thinning, the remaining trees usually increase nut or seed production. This provides food for wildlife, as well as creating a seed source for the next generation of trees.

Top view

Thin trees so that 12 to 15 feet are left on at least two sides of each crown.



Tree selection

The two main factors that limit tree growth in Missouri are sunlight and moisture. The competition among trees for sunlight in the crowns is readily visible and uncomplicated. The corresponding competition for moisture and growing space in the soil is much more complex and difficult to observe. For this reason, crown competition and several other factors to be discussed later will be used to determine which trees to cut and which ones to leave.

The easiest way to get started is to walk through the woods and observe the form, condition and size of the different trees. The trees in the stand can be placed in three categories.

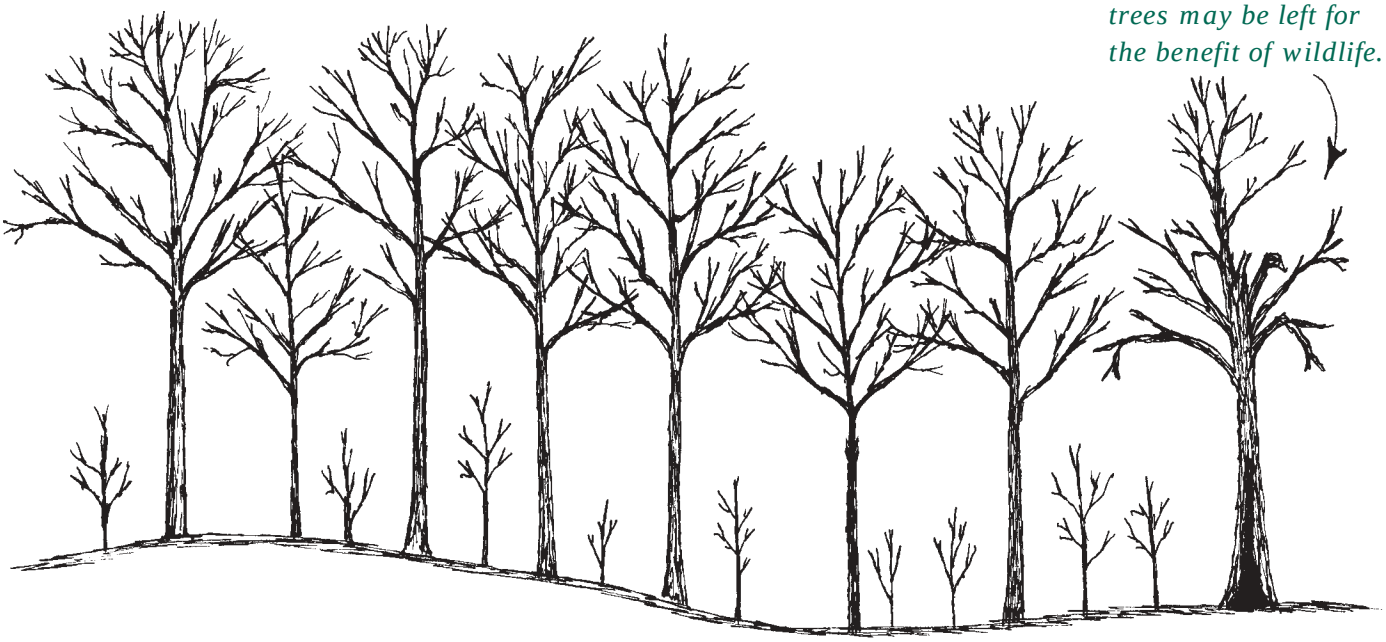
The first and most important

Future results

Side view

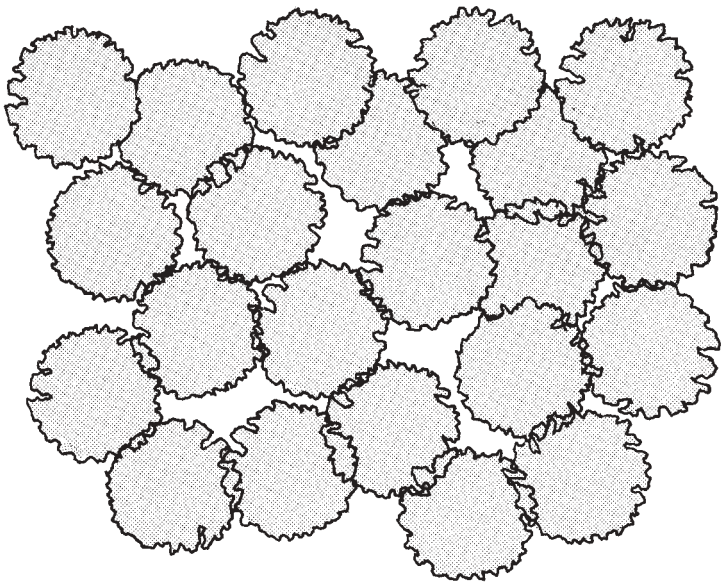
Trees with greater value are produced in the shortest time in a managed stand. Harvest and regrowth are part of the management cycle.

Some older, hollow trees may be left for the benefit of wildlife.



Top view

The best trees use available growing space. For good forest management, future thinnings may be carried out for fuelwood cuttings or timber sales when needed.



group are the trees that will be the final crop. These should be of desirable species and have tall, straight, clear trunks free from insect or disease damage, fire scars, decay or mechanical damage. The crop tree should have a full, healthy crown with no large dead branches. The crowns should be at the general level of the crown cover or extend above it and receive full sunlight. Once the crown of a tree has been reduced in size by its competitors, it cannot always be restored to a dominant position by thinning. Therefore, it is better to encourage the dominant trees rather than try to revive those that have fallen behind.

The second group comprises those trees that will be removed in future thinnings, but will be needed in the meantime to fill growing space. It is important to maintain the proper number of trees on a given acre to fully use the growing space. If there are too many trees, they will be crowded and cannot realize their full growth potential. On the

Cherrybark oak

other hand, if all but the crop trees are removed in one thinning, the land is not producing all the wood of which it is capable. The quality of the remaining trees also will decline due to less height growth, persistent lower limbs and wind damage.

The final category comprises the surplus trees that are to be removed in the first thinning. These trees are the least desirable in the stand because of species or form. They should be deadened or cut for firewood as soon as possible. The characteristics that make the trees in the second and third categories undesirable as crop trees are:

- Low-value species
- Multiple sprouts from one stump
- Low-forked or crooked
- Swellings or bumps on the trunk that indicate internal damage
- Fire scars or other damage to the trunk
- Cull trees or wide-spreading trees with excessive limbs.

When selecting the species to leave, remember that individual species will grow on the sites best suited for them. Some species naturally have a higher commercial value than others, and these are the ones to favor when faced with the choice between two species. Several of the more valuable species in Missouri are black walnut, white oak, black oak, red oak, ash, silver maple, pine, yellow-poplar and sweetgum. Some species usually considered not marketable as sawlogs are honeylocust, blackjack oak, mulberry and American elm. Although you have to work with the species you have available, any species will be of higher quality if it has had some care rather than being left to fend for itself.

You can continue crop tree release as described in the above section. Select well-formed crop trees and remove competing trees within 15 feet of the crop tree's crown. This gives the remaining trees enough additional sunlight to maintain good growth rates.

You also can apply an area-wide thinning to reduce the overall number of trees in the stand. This involves measuring the average basal area of the stand and using a stocking chart to determine the number of trees to be removed. See Appendices 11 and 12.

When thinning, stocking levels usually are reduced to the B-level line. Use the instructions in Appendix 12 to find the number of trees per acre to be left after thinning and their average spacing.

Since trees do not grow in even spacing, it is impossible to adhere strictly to either of these methods. Two good trees may be left with their crowns touching when they have open space on two other sides and enough growing room. In some crowded stands, it may be necessary to remove defective trees, as well as some good trees, to maintain proper spacing. Aim for the averages as this will ensure proper spacing to fully use the site.

The two methods described above thin the tree crowns in the main canopy, rather than in the understory. The understory trees are already deprived of sunlight and removing them will not have much effect on the main stand. Many times, the vegetation in the understory is referred to as "brush," and efforts are made to eliminate it. A closer look may reveal that the "brush" is actually small saplings of desirable tree species. These saplings are the next generation of trees, waiting for a larger tree to die or be removed to give them the sunlight and room they need to grow into the canopy.

See chart on species recommendations for timber production based on site index on page 93 for more information on how to identify the most desirable species in your stand.

Multiple stems

Trees with multiple stems are common in Missouri's forests. Hardwood species sprout readily from the stump following cutting

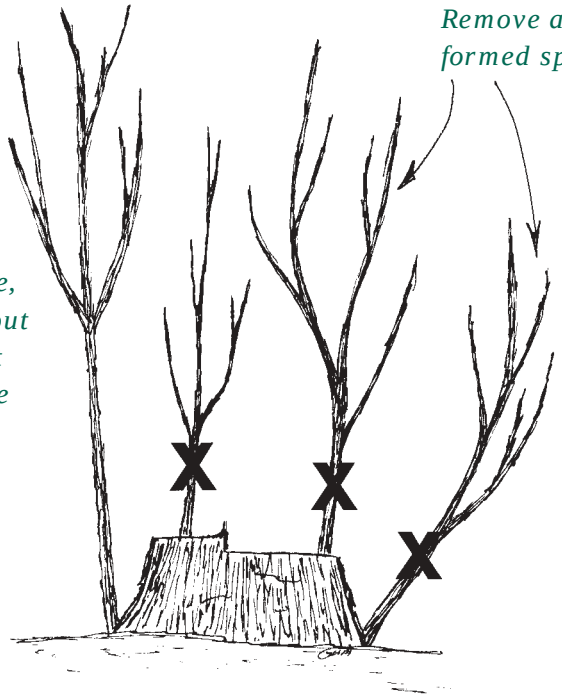
or fire. These multiple-stem trees can develop into quality single-stem trees if they are treated early enough. Multiple sprouts are best treated when they are less than 20 years old or 5 inches in diameter at breast height. When treated at this size, the selection of the best sprout is easy; and the wounds from removing the extra sprouts heal quickly.

On small sprouts originating from a large stump, select a sprout originating at or below ground line and cut off all the others. A sprout arising low on the stump is less likely to decay from the wound left when the parent stump rots.

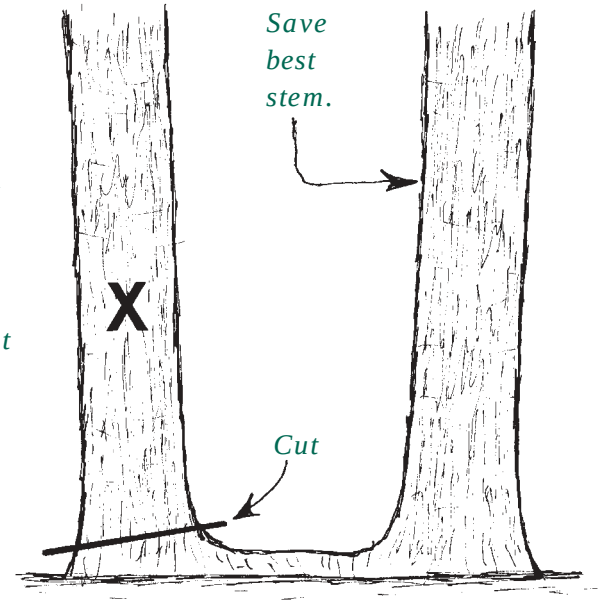
Multiple sprouts that are joined at the base with a V-shaped crotch are more of a problem. It is difficult to remove one stem without leaving a large wound through which decay will develop in the remaining stem. In this situation, it is better to remove the entire clump and encourage the development of a nearby single-stem tree.

Sprouts with a low U-shaped crotch (wide enough to place your foot between the stems) are easy to correct. For any diameter sprout, pick the best one and cut the others off at a convenient height. A double-stemmed tree that is larger than 12 inches in diameter is approaching commercial sawlog size. It is best to leave the tree if it is of good form and to harvest it during the

Selecting a stump sprout

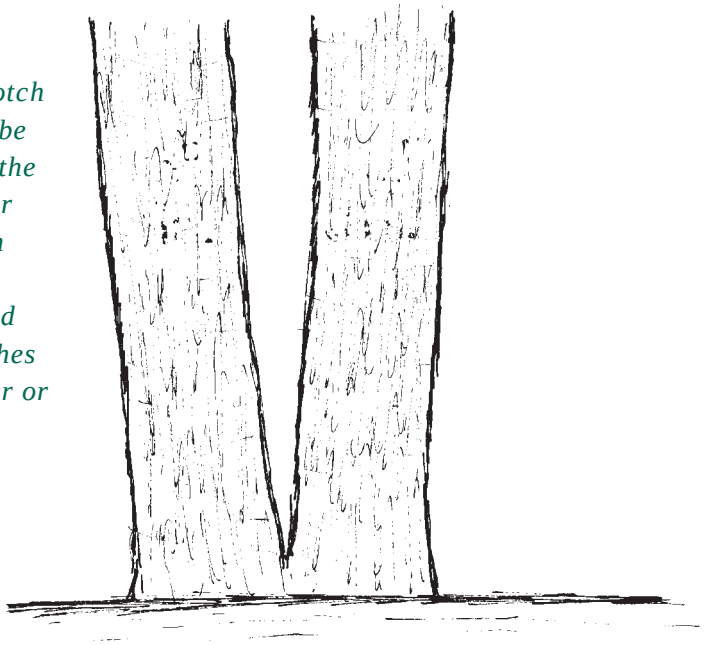


Selecting the best stem of a U-shaped crotch



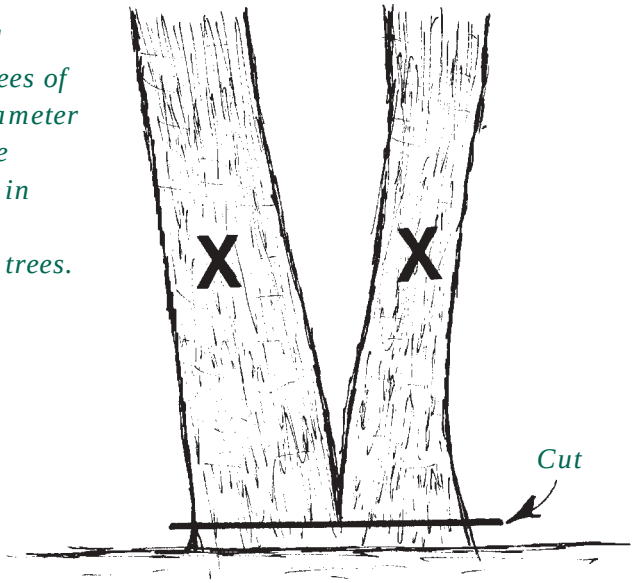
Large, V-shaped crotched trees

Large, V-shaped crotch trees may be kept until the next timber sale if both stems are healthy and are 12 inches in diameter or more.



Smaller, V-shaped crotched trees

V-shaped crotch trees of small diameter should be removed in favor of adjacent trees.



next commercial timber sale.

To prevent sprouting from the stumps after cutting, treat with a woody plant herbicide. Since many of the trees removed are undesirable, the sprouts from their stumps will not be wanted in the future timber stand. Check with your local forester or University Outreach and Extension office for the names of herbicides approved for woody plant control.

The herbicide should be applied to the stump immediately after the tree is cut. If several days pass before the chemical is applied, the herbicide will not be absorbed into the stump and will be ineffective. As with any chemical, herbicides should be used only according to label directions.

Pruning

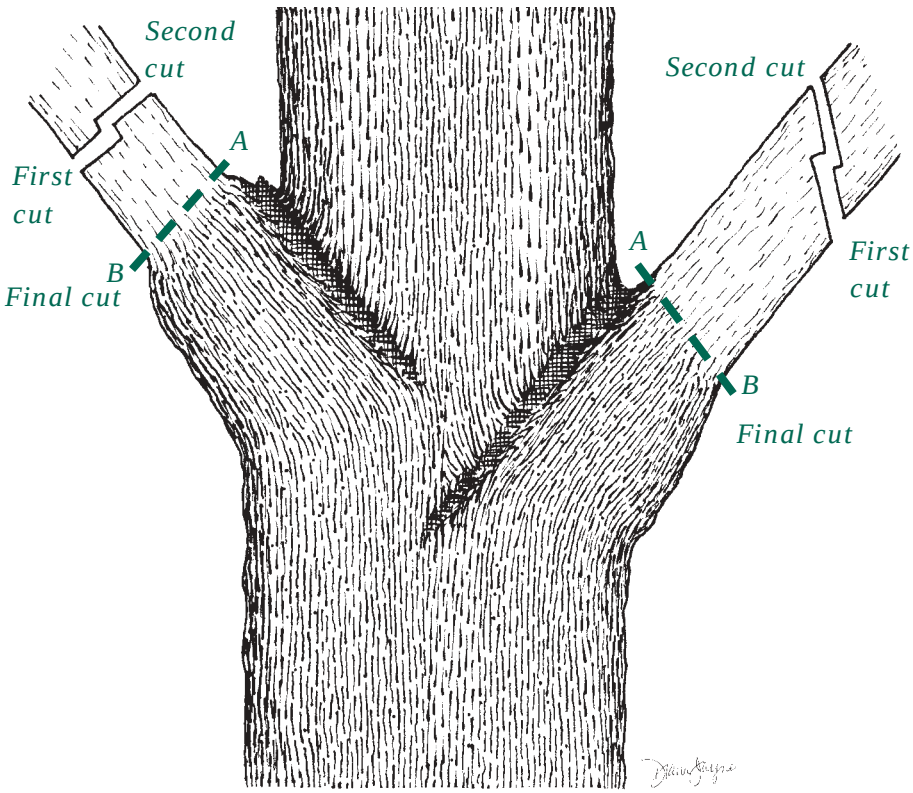
Pruning forest trees is usually reserved for high-value species, such as black walnut or other potential veneer trees. Pruning removes lateral branches, resulting in clear, defect-free wood. Local markets will determine whether you should prune your trees. Pruning should begin when the tree is young and continued as necessary as the tree grows. Follow these guidelines to prune forest trees:

- The best time to prune is in the late dormant season. It is best to avoid pruning when leaves

are forming in the spring and are falling in the fall.

- Prune branches when they are less than 2 inches in diameter.
- Prune live branches as close as possible to the trunk, but do not cut behind the branch bark ridge. Each branch has a thick bark ridge separating it from the main stem. When branches are pruned properly, a ring of callus will form a circle or "doughnut" around the cut after the first growing season.
- Do not cut behind the branch bark ridge. Do not leave stubs. Do not use flush cuts. Do not paint cuts.
- If removing dead branches, do not cut into the collar that has formed at the base of the dead branch.
- Remove no more than 25 percent of the live crown at any one pruning and maintain a 50 percent live crown/stem ratio.
- Eventually prune the first 17 feet of the trunk to produce a 16-foot clear log.

Pruning tips



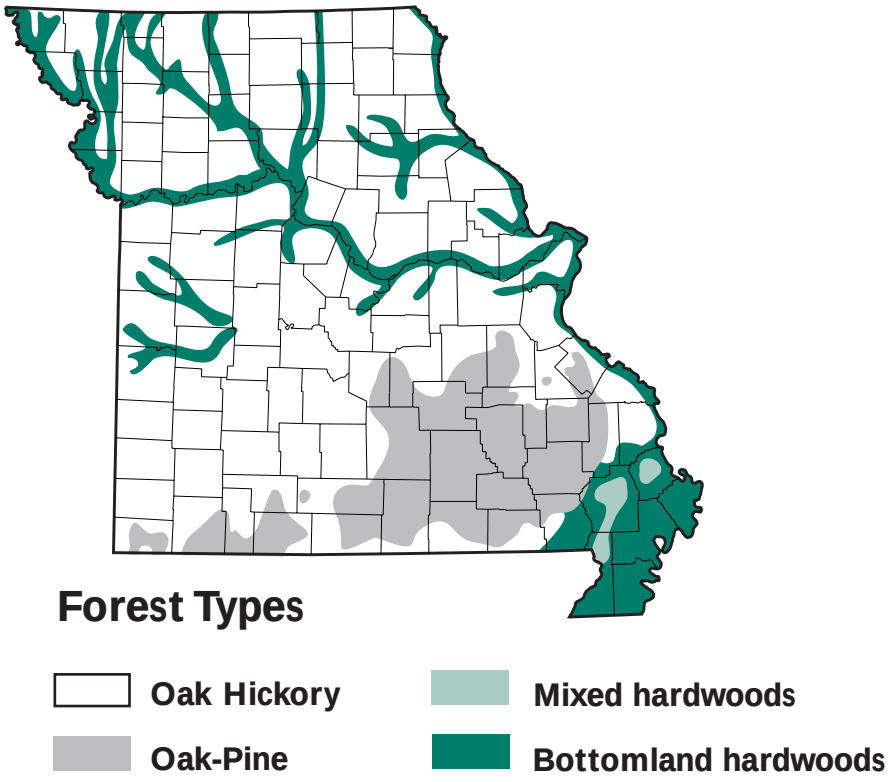
To prevent bark from tearing off below the limb,use the three-cut method when pruning. Make the final cut between A and B along the natural branch collar. Do not make the final cut flush with the trunk.

Managing Important Forest Types

Oak-Hickory

This upland forest type covers the greatest area in Missouri. Oaks dominate, with white, black, scarlet and northern red oak being the most common. Post and blackjack oak occur often on drier areas. Less common are southern red, chinkapin, bur and pin oak. Hickory is a minor but consistent part of the association.

Other important overstory species are blackgum, red and sugar maple, ash, elm, black walnut and redcedar. Many understory species occur in oak-hickory forests. The most common are flowering dogwood, sassafras, redbud, serviceberry, eastern hophornbeam and American hornbeam.



Missouri lies on the western edge of the Central Hardwood Region. This area covers about 100 million acres, stretching from Missouri to Pennsylvania and from Tennessee to the Lake States. The forests of this region contain more than 70 deciduous tree species, several evergreens, and many shrubs and forest plants. The four broad forest types, often called associations, that occur in Missouri are shown in the map above.

Regeneration

Oaks commonly reproduce from acorns. Good acorn crops are produced every two to five years. Acorn weevils and foraging wildlife reduce the number of viable acorns. Best germination occurs in mineral soil under a light covering of leaves. An oak seedling may live as long as 20 years in the shade of the overstory until an opening is created in the canopy.

Hardwoods also sprout from stumps following a harvest. Stump sprouting declines as the diameter of the stump increases. Assessing the number of seedlings in the understory and the probability of stump sprouts will help determine which regeneration method is best.

The seed-tree method is not recommended for regenerating oaks. Leaving scattered seed trees will result in poor distribution of the heavy seeds.

Stands that are well stocked with advance regeneration are good candidates for clearcutting. A clearcut should be at least 2 acres in size, otherwise shade from the surrounding stands will suppress seedling growth.

If there is a good source of seed but few seedlings, shade may be the problem. A shelterwood cut removes the overstory in a series of harvests while the new stand

becomes established in the understory. The length of time to establish the new regeneration and remove the overstory may take as long as 20 years.

Single-tree selection is not recommended for regenerating oaks. This method favors the shade-tolerant species, and it gradually reduces the number of oaks in the stand.

Group selection can be used to regenerate oaks. To maintain the uneven-aged appearance of the stand, the diameter of the harvest opening should not exceed one to two times the height of the surrounding trees.

Intermediate treatments

See Forest Improvement Practices section on page 27.

Oak-Pine

This upland type occurs on the drier sites in the southern and southeastern Ozarks. It is similar to the oak-hickory type, except that shortleaf pine makes up 25 to 50 percent of the stand. The remainder is primarily oaks, but other hardwoods associated with oak-hickory also may be present.

Regeneration

Any of the even-aged methods and the group selection method are suitable for regenerating oak-pine stands. Maintaining the pine component is likely to be difficult because the understory is dominated by hardwoods. The oaks will come from advance regeneration and are usually well established. The amount of pine regeneration will be determined by the presence of a seed source and intensity of site preparation.

With the seed-tree method, leave 10 to 15 seed-producing trees per acre indicated by old cones hanging on the trees. Control undesirable hardwoods in the understory and prepare a seedbed. Pine seed needs bare mineral soil to germinate.

Sometimes the disturbance caused by harvesting and skidding logs creates enough bare soil, or the area can be prescribed burned. Harvest the seed trees two to three years after adequate pine seedlings are established.

Clearcutting will create the light and seedbed conditions necessary to regenerate pine. Remove the overstory and control unwanted hardwoods. Prepare a seedbed as needed. Supplementary direct seeding of pine will increase the amount of pine in the next stand.

The shelterwood method will regenerate pine as long as enough overstory is removed. Reduce overstory stocking to 60 percent, leaving seed-producing pine trees scattered over the stand.

Control unwanted hardwoods and prepare a seedbed as needed. Remove the shelterwood two to three years after sufficient pine seedlings are established.

To apply group selection, place groups so that seed-bearing pines are along or close to the border of the openings. Control unwanted hardwoods and prepare a seed bed. Remove all overstory trees in the opening.

Intermediate treatments

See Forest Improvement Practices section on page 27.

Mixed hardwoods

This forest type appears in one small area known as Crowley's Ridge in southeast Missouri. Mixed hardwood forests are a remnant from the geologic period when the Appalachians and Ozarks were one mountain chain. The principal species are yellow-poplar, sweetgum, white oak, northern red oak, American beech and sugar maple. Black oak, scarlet oak, cherrybark oak, white ash, red maple and blackgum occur frequently, and hickory is usually present.

Other species found in the mixture include basswood, buckeye, cucumbertree, black cherry, walnut and butternut. Understory species include flowering dogwood, redbud, American holly, hazel-alder, serviceberry, American hazel and American hornbeam.

Eastern cottonwood

Regeneration

The different silvicultural systems used to harvest forests control the amount of light reaching the forest floor. In mixed hardwood forests, there is a variety of desirable species with different tolerances to shade. This makes applying any one silvicultural system more complicated.

Black cherry, black walnut, oaks, ash and yellow-poplar are shade intolerant, so cutting methods that create lots of sunlight on the ground will encourage these species. Single-tree selection encourages shade-tolerant species, such as sugar maple, American beech and red maple. Group selection, clearcutting or shelterwood is usually recommended to maintain mixed hardwoods of several species. Through these methods, both intolerant and tolerant species can be grown together.

Intermediate treatments

See Forest Improvement Practices section on page 27.

Bottomland hardwoods

This type occurs on the flood plains adjacent to rivers and streams, and in the Bootheel of southeast Missouri. The land it occupies may be covered with standing water for long periods, as in the swamps of the Bootheel, or it may be subject to only short periods of flooding. Here, a great number of plant species make up the forest. Important species in river flood plains include pin and bur oak, cottonwood, elm, ash, willow, river birch, silver maple, sycamore, hackberry, sugarberry, pecan and sweetgum. In addition, baldcypress and water tupelo, as well as Nuttall, willow, cherry-bark, overcup, swamp chestnut and water oak are native to the swamps of the Bootheel.

Regeneration

Bottomland forests regenerate with species found in the overstory. These species reflect the timing, duration, water depth and sediment depth of past floods.

The three sources of regeneration are:

- advance regeneration
- stump and root sprouts from harvested trees
- new seedlings.

Bottomland forests can be managed under both even-aged and uneven-aged systems. Clearcutting and shelterwood should be used to create even-aged stands. The seed-tree method is not recommended. In clearcuts, sprouts plus new seeds deposited by wind or water over a two- to three-year period usually result in a stand of mostly light-seeded species. Shelterwood is the best way to regenerate heavy-seeded species that are growing in the overstory.

Group and single-tree selection can be used if you are willing to accept slower tree growth and a higher proportion of shade-tolerant species. Examples of shade-tolerant species favored by uneven-aged management include sweetgum, red and silver maple, green ash, hackberry and American elm.

Intermediate treatments

See Forest Improvement Practices section page 27.

Black walnut

Natural stands of black walnut are located throughout Missouri on bottomlands, coves and lower slopes. Walnut is generally found mixed with other trees, but pure stands do occasionally occur. It has demanding site requirements and only grows well on good-quality land.

Black walnut grows best in soil that is medium textured, deep and well drained, but not stony, and is found on lower north- or east-facing slopes. Poor sites include steep south- and west-facing slopes, narrow ridgetops and poorly drained areas. Soils with clay subsoils, gravel layers or bedrock within 2 1/2 feet of the surface are not suitable for planting walnut.

Regeneration

Black walnut plantations can be established by planting seeds or seedlings. Most are started by planting bare-root seedlings because it's more predictable than planting seeds and cheaper than planting containerized seedlings. Site selection is critical. Consult your county's soil survey and dig a few soil pits to verify the soil is suitable over the entire planting area.

Site preparation and follow-up weed control are equally important. Competing weeds, grass and brush rob walnut seedlings of moisture, nutrients and light. Competition may be controlled by mechanical or chemical means. Cultivation is the most effective mechanical weed control. It works well for site preparation, but may damage feeder roots and lateral branches if used for follow-up care.

Chemical control works better and is cheaper than mechanical control, but it must be done with care. Several chemicals are approved for use with walnut. Consult with your local forester or University Outreach and Extension office for the best chemical for your situation.

Chemicals may be applied in a 4-foot wide strip down the tree row or in a 4-foot diameter circle around each tree. Weed control should be continued for at least five years after the trees are planted. Mulching with bark or sawdust is good weed control, but is only practical in small areas.

For timber production, walnut is usually planted on spacings of 10 or 12 feet square (436 or 302 trees per acre, respectively). Wider spacings may be used for nut production or agroforestry applications. Wide spacings allow the use of farm equipment for weed control and intercropping of other products while the walnuts are still young. For more information on planting and handling seedlings, see Artificial Regeneration section on page 22.

Intermediate treatments

Clear knot-free wood is one thing that makes walnut so valuable. Pruning lateral branches can greatly increase the value of a tree. Pruning can begin when the trees reach 10 to 12 feet in height and limbs are still small. Pruning should be confined to the lower half of the trunk. At least half the tree should be left in branches, and the leaf area should not be reduced by more than 25 percent in any one year.

Prune branches when they are less than 2 inches in diameter. The dormant season is the best time to prune. Continue to prune periodically until at least the first 9 feet of the trunk is clear. The minimum length of veneer logs is normally 8 feet. If you want a large-crowned tree for nut production, stop pruning at 9 feet. If wood production is your objective, prune to at least 17 feet, so two veneer logs are produced. See the section on pruning on page 33 for more information.

Deaden grape vines growing in walnut trees. Virginia creeper and poison-ivy also may be found, but grape is the most damaging. Vines can deform the trees and eventually kill them. Release the tree by severing the vine and treating the cut ends with an approved herbicide. It is not necessary to pull the vine from the tree. It will fall as it rots.

In natural stands and eventually in plantations, walnut trees need to be thinned to maintain good growth. Although walnuts are very sensitive to crowding, they respond well after thinning. Straight, clear-stemmed, healthy trees in the dominant or co-dominant crown classes should be chosen as crop trees. Release is best done when the trees are still young and before they have been crowded too long.

Remove poorer quality trees and undesirable species to increase the growing space on at least three sides of the crop tree's crown. As a general rule, there should be at least 10 feet between the walnut crown and any adjacent tree crowns. Periodic thinnings will be needed as the walnut crown grows into the available space.

Forest Protection

Scarlet oak

Insects and diseases

Hundreds of species of insects and diseases occur naturally in a forest. While some of them may be harmful, most are not. Some are even beneficial. Many insects and fungi return nutrients to the soil by breaking down fallen leaves and woody material.

These insects and diseases are an important part of healthy forests. While they influence all aspects of forests, individual outbreaks usually have little long-term negative effects. Defoliation of one species may result in slower growth and even some mortality, but other tree species may respond with increased growth and regeneration. Animals that feed on insects may thrive on the abundant food during outbreaks.

Missouri forests have evolved with the naturally occurring insects and diseases over thousands of years. Natural control mechanisms, such as birds, animals and insects, usually keep pest populations under control without human intervention. However, pests introduced from other countries that have no natural controls cause the most damage to our forests.

Dutch elm disease is one such example. Introduced from Europe, Dutch elm disease is deadly to the American elm. In fact, it is the most destructive shade-tree disease in North America. Virtually all American elms died in the 41 states that have reported the disease.

Chestnut blight and gypsy moth are other examples of introduced pests. Chestnut blight has killed nearly every American chestnut tree in the United States. Gypsy moth was introduced into the eastern United States and is spreading west. It will be especially devastating to Missouri forests because oak leaves are the gypsy moth's favorite food.

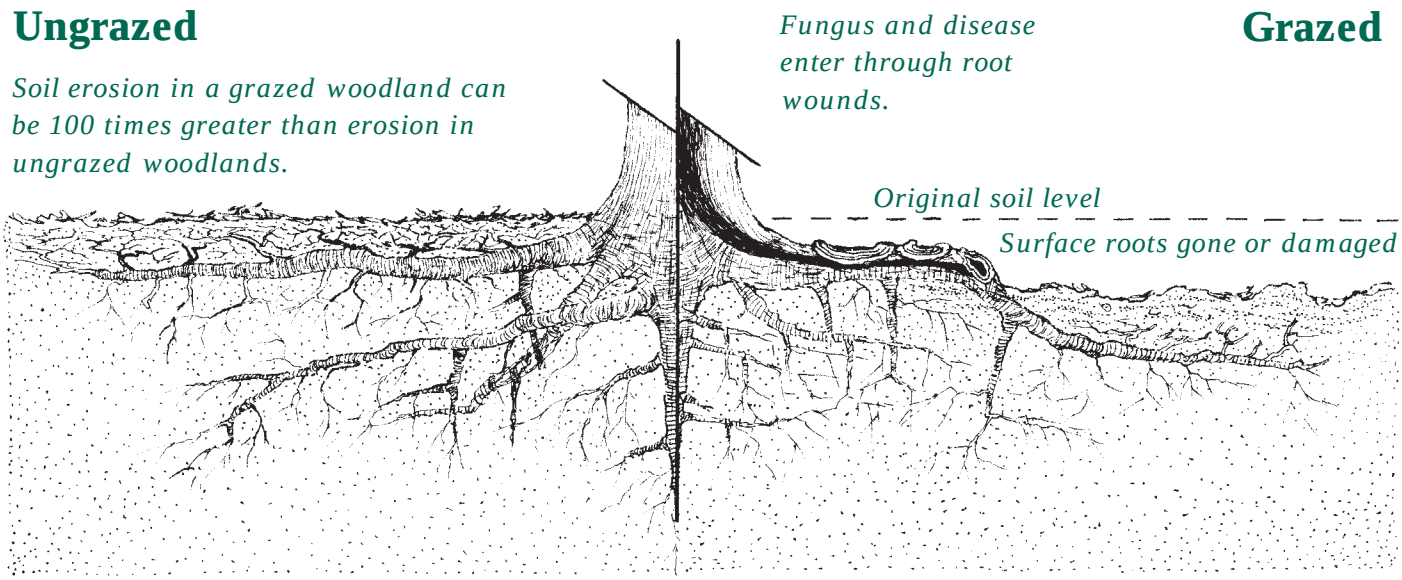
Controlling these pests is often difficult. Pesticides are used to protect high-value ornamental trees, but the expense is usually not justified in forests. Pesticides can cause damage to nontarget insects and animals. If not properly applied they may pollute the environment or harm the person applying the chemical. Before using any pesticide, contact your local forester or University Outreach and Extension specialist for positive identification of the pest so the correct pesticide can be used. It is against the law to use a pesticide inconsistent with its labeling.

The best protection for trees is to keep them healthy and growing. Below are some integrated pest management strategies you can use to minimize pest damage.

- Maintain tree species diversity along with a mixture of ages and sizes of trees.
- Match tree species to the sites where they grow best.
- Maintain the vigor of your forest through regular thinnings.
- During thinnings, remove low-vigor trees, infested trees and those that are especially susceptible to local pest problems.
- Leave snags for cavity-nesting birds.
- Avoid pruning or thinning during the growing season.
- Use only native planting stock.
- Avoid wounding trees when operating heavy equipment or logging.
- Periodically scout trees to identify pests before they cause too much damage.
- Use the most biologically and environmentally sound methods of pest control when a problem is found.

Fire benefits and prevention

Fire is a natural event in most forest ecosystems. Some forests depend on fire to recycle nutrients back into the soil. Some trees depend on the heat of a fire to open their cones and release seeds. Other trees, like shortleaf pine, need fire to bare the soil for germinating seeds and to open the forest canopy to provide warmth and sunlight. Fires that



occur when lightning strikes in dry fuel make up less than 1 percent of Missouri's wildfires.

An intentionally set fire can be a useful tool in maintaining or restoring plant communities, when used for specific sites and conditions. These prescribed fires are planned to burn under exact weather and fuel conditions to accomplish certain changes in the vegetation.

On the other hand, unplanned wildfires can cause great damage to a woodlot. They may weaken or kill trees, cause wounds where insects and diseases can enter, increase soil erosion, and damage wildlife and recreational values. Often these fires are set by careless trash burners, who start 50 percent of Missouri's wildfires, or arsonists, who are responsible for 40 percent.

Follow these steps to help prevent wildfires in your woods:

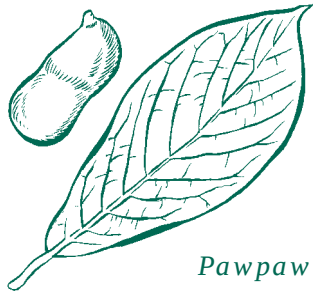
- Find out what agency or organization has fire control responsibilities in your area. Keep that phone number by your phone.
- If wildfires are a problem, maintain a cleared firebreak around your woodland.
- Build and maintain access roads to all parts of your property.
- Build a pond as a water source for fire trucks to refill their tanks. Wildlife will also benefit.
- Check bridges on your property to be sure they can support the weight of local fire trucks.
- After timber harvests, lop slash so that it lies close to the ground and decays quickly.
- During dry periods, ask visitors and workers not to smoke. Provide areas of bare soil to use during smoke breaks if needed.
- Mow road shoulders regularly. Burning materials thrown from cars are less likely to ignite in short grass.
- Park vehicles on roads or bare soil. Hot mufflers and catalytic converters can ignite dry grass.

Livestock grazing

For years, landowners have let domestic livestock graze in hardwood forests because the woods are cool in summer and sheltered from wind in the winter. Although it may seem like a good idea, grazing damages the forest, wildlife and soil resources.

After years of grazing, a forest begins to change. Livestock eat the young tree seedlings and saplings. When the trees are harvested, there are no young trees to take their place.

Typically, livestock like to eat



Pawpaw

An obvious "browse line" forms in grazed forests, destroying layers of wildlife habitat, as well as young seedlings and saplings.

the more palatable trees while leaving the less desirable species. Oak saplings are usually among the first to go. Hickory saplings are apparently less tasty and are more apt to survive. They also handle soil compaction much better. Livestock avoid honeylocust thorns, but will eat the seed pods and spread undigested honeylocust seeds everywhere.

Hungry livestock eat and destroy everything within their reach, causing a "browse line" that is easy to see. Wildlife that need low-growing plants for cover have difficulty surviving under these conditions.

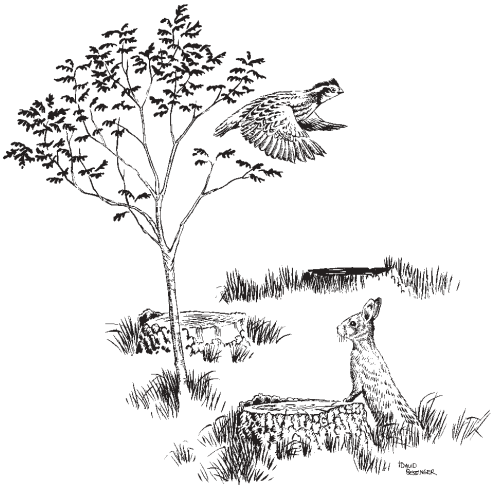
Grazed woodlots are also less healthy and vigorous than other forests, and their trees produce less wildlife food. Livestock may eat some food, such as acorns, leaving even less for wildlife.

Ungrazed forests often produce soil faster than it erodes. This is because leaves accumulate on the forest floor and gradually decompose. Soil erosion in a grazed woodland can be 100 times greater than erosion in ungrazed woodlands.

Large roots and hairlike feeder roots are easily damaged by trampling hooves as the soil erodes from around the base of a tree. Once exposed and damaged, insects and diseases have free entry into the roots.

Livestock also compact the soil, which causes real problems for trees. The small pores in the soil that allow tree roots to get air and water are sealed off. Rainwater that should soak into the ground simply runs off the surface. The weakened trees are less drought tolerant and are more vulnerable to insects and disease.

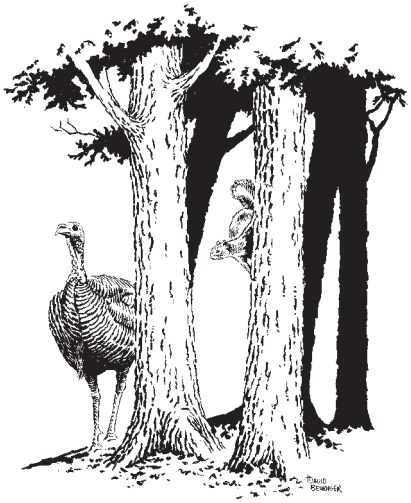
Hardwood forests produce little forage for livestock. One acre of well-managed pasture with either cool- or warm-season grasses is worth 20 to 40 acres of woodland pasture. Livestock shelter needs can be met by limiting use to only a small area of woodland. Fence livestock out of woodlots if you expect to grow high-value trees and produce quality wildlife habitat.



Just harvested up to 10 years

80 years or more
Ready for harvesting

10 to 20 years
Ready for thinning



60 to 70 years

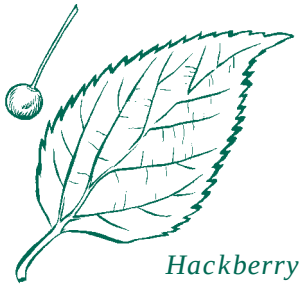
Wildlife and Forest Succession

The variety of cover conditions—from areas recently opened up by logging to stands of mature timber—provides different types of food and shelter required by many species of game birds and animals. New openings are sources of insects, berries and buds required by birds, such as grouse. Openings also yield heavy growths of browse for deer. As the trees mature, they produce the nuts and fruits preferred by turkey, squirrel and bear. Many birds and animals use the forest edge, the dense growth that fills in along the borders of new openings.

20 to 30 years

40 to 50 years

Wildlife Management



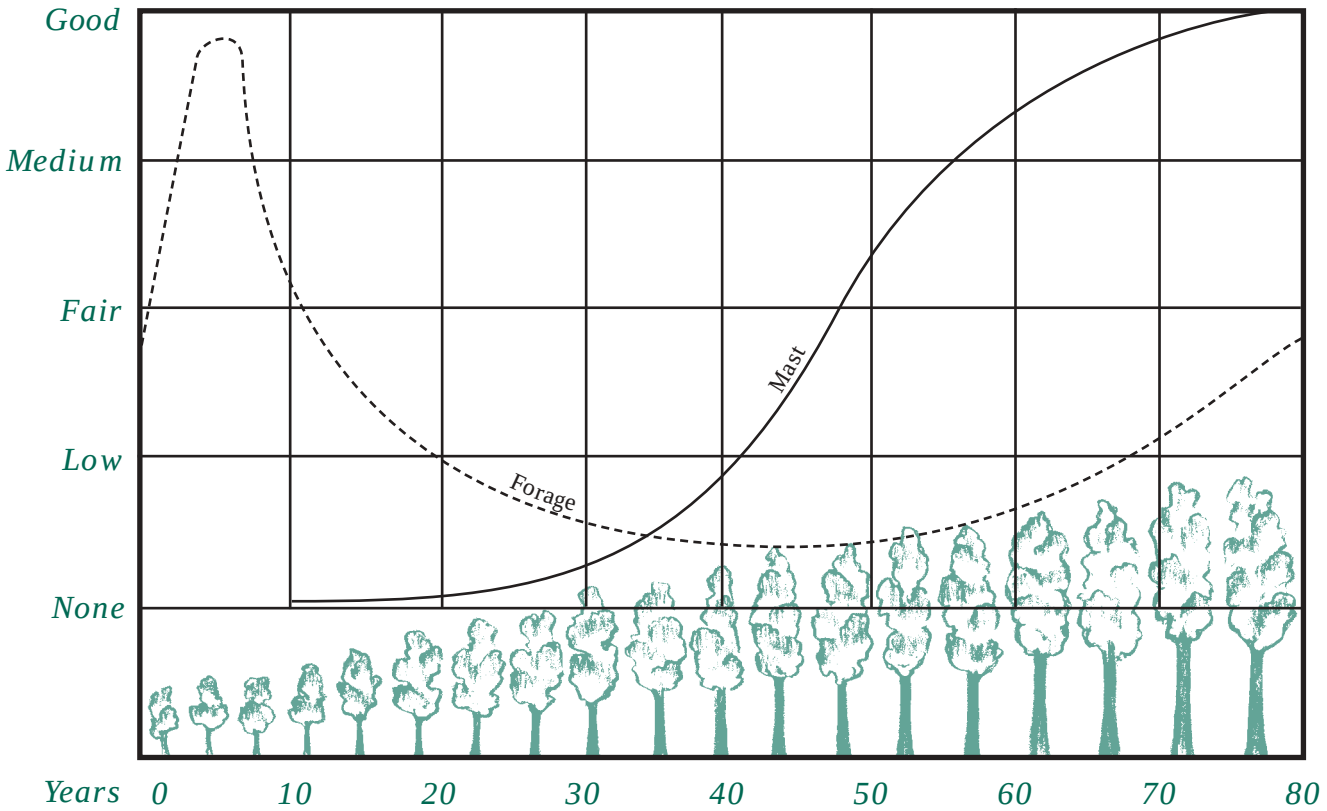
Hackberry

All wildlife need food, shelter and water within their home range, the area where an animal confines its activities. White-tailed deer range over several square miles while a gray squirrel may find all its habitat needs in two acres. Each bird or animal has a specific place and role—called a niche—within the forest ecosystem. Although some overlap occurs, these special niches allow many wildlife species to occupy different parts of the same forest. The more niches that can be created, the greater the number of species a forest can support.

Nature creates a variety of niches on an irregular basis—some by means that are not always socially or biologically acceptable, such as wildfire. In the past, natural events, such as wind storms, tornadoes or fires, created different habitats in Missouri forests on a variable and often large scale. The natural occurrence of fire or wind disturbance is unpredictable and uncontrollable.

Forest management practices imitate these natural disturbances, but on a much smaller scale and under closely controlled circumstances. Regulated harvesting provides different niches, but without the "feast or famine" of unpredictable natural disturbances. The aim of forest management is to create a balance of habitat types to support a variety of species over the long term.

Good forest management and good wildlife management are not mutually exclusive. The same basic practices that produce a healthy forest also can produce healthy wildlife populations. The following sections offer ways you



This chart shows the relationship of mast and forage production to stand age in even-aged hardwood forests.

By increasing the sunlight in young stands, you can promote browse, forage and seeds for wildlife.

can improve wildlife habitat while keeping your woodlot healthy and productive.

Young stands

During the seedling-sapling stage, concentrate any work on understory development. By thinning newly regenerated stands, you increase sunlight, which promotes the abundance and nutritional value of herbaceous vegetation.

Thinning allows you to favor understory species that provide browse, forage and seeds for wildlife. Precommercial thinning in sapling stands promotes diversity, which benefits both timber and wildlife as the stand matures.

Ways to improve young stands for wildlife:

- Retain snags and den trees left from the regeneration harvest.
- Favor mast-producing species in precommercial thinnings. Thin to a wide spacing of 10 feet by 10 feet between selected crop trees to delay crown closure.
- Maintain a combination of hard mast trees (oak, hickory, walnut) and soft mast species (dogwood, blackgum, blackberry) in each stand.
- Pile slash from thinnings to provide cover.
- Mow old logging roads and landings to encourage herbaceous plants. They also can be overseeded with legumes.

Examples of wildlife that use young stands include five-lined skink, northern fence lizard, wild turkey, song sparrow, yellow-breasted chat, red bat, gray fox and bobcat.

Immature stands

Immature stands include those up to 60 years old or that have sapling-, pole- and small sawtimber-size trees. Compared to younger regenerated stands or more mature stands, these pole-size trees are too young to produce much mast for wildlife; and grasses, forbs and shrubs common in young stands have been shaded out. Any cover provided by logging slash has decomposed.

Immature stands also lack several important habitat components: browse, cover, mast and cavities. This condition, however, is temporary and will change as the stand matures. It is important to remember that in a managed forest, the quality of wildlife habitat depends on the entire mosaic of forest stands. It is not necessary to “improve” every pole stand when habitat is provided in nearby younger and older stands.

Shellbark hickory

Immature stands consist of mostly sapling-, pole- and small saw-timber-size trees. They often lack browse, cover, mast and cavities for wildlife.

Ways to improve immature stands for wildlife:

- Retain any snags and den trees.
- Thin to encourage understory development and increase crown size for mast production.
- When thinning, release desirable species with good form and vigor that are good mast producers.

Examples of wildlife that use immature stands are midland brown snake, five-lined skink, ruffed grouse, eastern screech owl, summer tanager, little brown myotis, woodland vole and white-footed mouse.

Mature stands

Stands older than 60 years or that are medium- to large-saw-timber size generally provide good wildlife habitat. Mature trees usually produce abundant mast and provide den sites. The understory in these stands produces moderate amounts of browse. Thinned trees in mature stands often can be sold for timber.

Some of these stands can be set aside as old growth. A number of cavity-nesting species prefer the conditions found in old growth forests. The stands that are set aside must be held past the usual rotation age so there will be declining trees and a multi-layered structure. Stands dominated by white oaks can be held 150 to 200 years; black oak stands begin to decline after 100 years.

When selecting stands to set aside as old growth, first consider stands more than 90 years old with large defective trees. If these are not available, select “old growth” from stands more than 50 years old. These have the potential to develop the large tree, multi-layered structure.

Ways to improve mature stands for wildlife:

- When thinning, modify cutting guides to: 1) retain active den trees; 2) leave unsalvageable dead trees standing; and 3) when other factors are equal, favor mast producers over non-mast producers.
- Stands designated as old growth should be as least 15 acres in size with a minimum width of 200 feet.

Many species of wildlife use mature stands, including spotted salamander, broadhead skink, gray treefrog, downy woodpecker, ovenbird, Kentucky warbler, gray squirrel, raccoon and eastern chipmunk.

Timber sales

Regeneration cuttings affect wildlife more drastically than

most forest management practices because a mature forest stand is replaced by a young sapling stand. Regeneration cuttings quickly provide habitat for many wildlife species, but they also influence wildlife use of the new stand throughout the rotation. Retaining snags, cavity trees, potential snags and den trees in regeneration areas and excluding other areas from harvest will benefit many wildlife species.

The regeneration method you use influences the species composition of the new stand. Even-aged and group selection methods are preferred for regenerating Missouri hardwoods because they favor mast-producing oaks and other intolerant species. Cover is another important benefit provided by regeneration. Abundant herbaceous and young woody vegetation also provide deer browse.

Ways to promote wildlife while cutting timber:

- Retain snags and den trees. See the next section for recommendations on promoting them.
- Save special trees along woodlot edges, such as den trees, snags and scarce species. Fruiting trees and shrubs are especially valuable along edges because sunlight stimulates heavy fruiting.
- Maintain a 100-foot-wide buffer on both sides of streams.
- Protect sensitive habitat, such as cave openings, wetlands, heron rookeries, rare plant communities or raptor nests.
- Seed logging roads and landings in grasses and legumes.

Mature stands have an abundance of mast and den sites for wildlife. The understory also provides some browse.

Snags and den trees

Both snags and den trees provide essential food and cover for many species of wildlife. Snags are standing dead trees, while den trees are alive with a cavity in the trunk or limbs large enough to shelter wildlife.

Snags

Once a tree dies, the slow process of decay begins. While decaying, birds use snags for perching, feeding and nesting. As the center of the snag softens, birds such as woodpeckers hollow out nest holes, which are later used by chickadees, kestrels and screech owls. Many birds eat insects from snags, which prevents serious insect and disease problems in other trees. Large fallen trees can provide important habitat for grouse, chipmunks, salamanders and frogs for up to 50 years.

When managing woodlands for

Old growth forests typically contain both dead and overmature trees, plus other trees and shrubs at a variety of heights.

wildlife, consider the following minimum recommendations:

1. Leave or establish per acre:
   a. One snag larger than 20 inches DBH for pileated and red-headed woodpeckers
   b. Four snags between 10 and 20 inches DBH for species, such as flying squirrel and the American kestrel
   c. Two snags between 6 and 10 inches DBH for species, such as the eastern bluebird and black-capped chickadee.
2. If not enough snags are present, deaden live trees by cutting a 3- to 4-inch wide band around the tree with an axe or girdling the tree with a chainsaw.
3. Trees should not be deadened to create snags in areas of limited forest habitat, such as along streams, fence rows, narrow drainages or small isolated woodlots.

Den trees

Many birds, mammals and reptiles use tree cavities throughout the year for nesting, cover and protection from the weather. Typical woodlots usually do not have enough cavity trees, so it is very important to protect the existing or potential den trees. Wolf trees—old, open-grown, large-crowned trees—are potential den trees that are especially valuable because they also produce food.

Future den trees will show signs of rot, such as decayed branches, fungi or wounds and scars. Woodpecker activity also is a sign of disease or insect infestation. Good places for den trees are along streams and fence rows, as well as near small isolated woodlots. Not all old, damaged trees make good den trees, however. For example, hollow trees broken off at the top offer little wildlife protection from the weather.

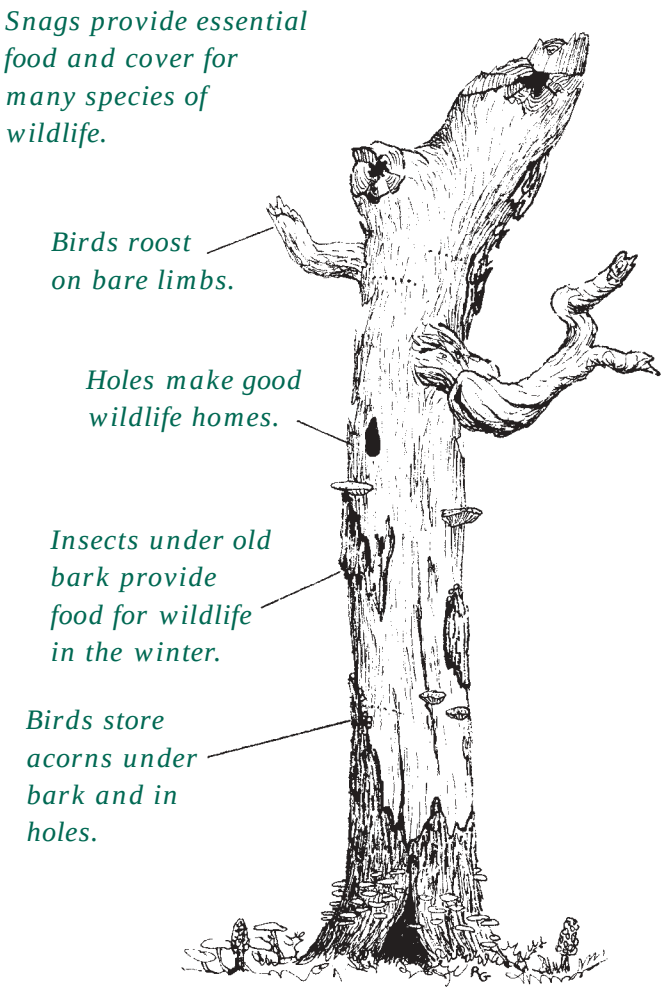
White oak, post oak and many other oaks make the best den trees because they are long lived. Other species, such as hickory, American elm, sugar maple, American sycamore, eastern cottonwood, blackgum, ash and basswood, also make excellent den trees.

Woodland management for wildlife should consider the following minimum recommendations:

1. Leave or establish per acre:
   a. One den tree larger than 20 inches DBH for barred owls, fox squirrels and raccoons.
   b. Four den trees between 10 and 20 inches DBH for species, such as gray squirrels and red-breasted nuthatches.
   c. Two den trees between 6 and

10 inches for birds, such as tufted titmice and house wrens.

2. Do not harvest den trees in regeneration cuts.
3. Where none exist, future den trees can be created by wounding selected trees so decay organisms can enter the tree. Although it may take years to develop, these cavities will improve wildlife habitat for the future. See below for ways to create den trees:
   a. Cut a limb—the larger the better—about 6 inches from the trunk of the tree. Ash, elm, cottonwood, sycamore, silver maple and basswood are good trees to use.
   b. Chop out a 6- by 6-inch section of bark on the trunk of a tree that shows signs of damage or decay.
   c. Drill a hole at least 2 inches in diameter and 3 inches deep into a suitable tree. It's best to make the hole under a limb that is 3 inches or more in diameter.
   d. For quicker results, put up bird houses and den boxes.



Edges and openings

Edge is the transition zone between habitat types. This zone often offers food and cover to many wildlife species. High-quality edge is a wide band of plants that gradually changes from one type of vegetation to another. It has grasses, weeds, shrubs, vines and small trees that provide wildlife food, such as berries, seeds, browse and insects. Edge also may offer cover for nesting and protection from weather and predators.

Good edges usually require deliberate action. Edge can be created by planting shrubs or small trees in a 30-foot or wider strip at the edge of a field.

Another option is to allow the border to naturally revert to native plants. The natural process is rapid after the elimination of livestock, plowing and mowing. Conversion of heavy sod, such as fescue, can be hastened by plowing, disking or applying herbicide to the border.

If a field is bordered by trees that affect the growth of crops, it may be cost effective to let an edge develop between the trees

Kentucky coffeetree

and field. The return from low-yield edges may not offset the cost of seed, fertilizer and planting. Large trees of low value within 30 feet of the crop field should be felled or deadened to allow sunlight to reach the understory. Within 15 feet of the field, small trees, such as dogwood, hawthorn, plum and redcedar, should be cut to encourage annual weeds, shrubs and sprouts. Trees should be cut low to encourage sprouting.

Large forested tracts often lack openings. Annual weeds, grasses and seedlings found in these openings produce food, nesting sites and escape cover for wildlife. Five to 10 acres of small openings per 100 acres of forest is desirable. These openings should range from 1 to 3 acres. Pastures and fields surrounding small woodlots will reduce the need for openings. Roads in the woods, utility rights-of-way, log landings or small clearcuts also can provide open areas for wildlife.

An ideal edge has crops, shrubs, small trees, then large trees.

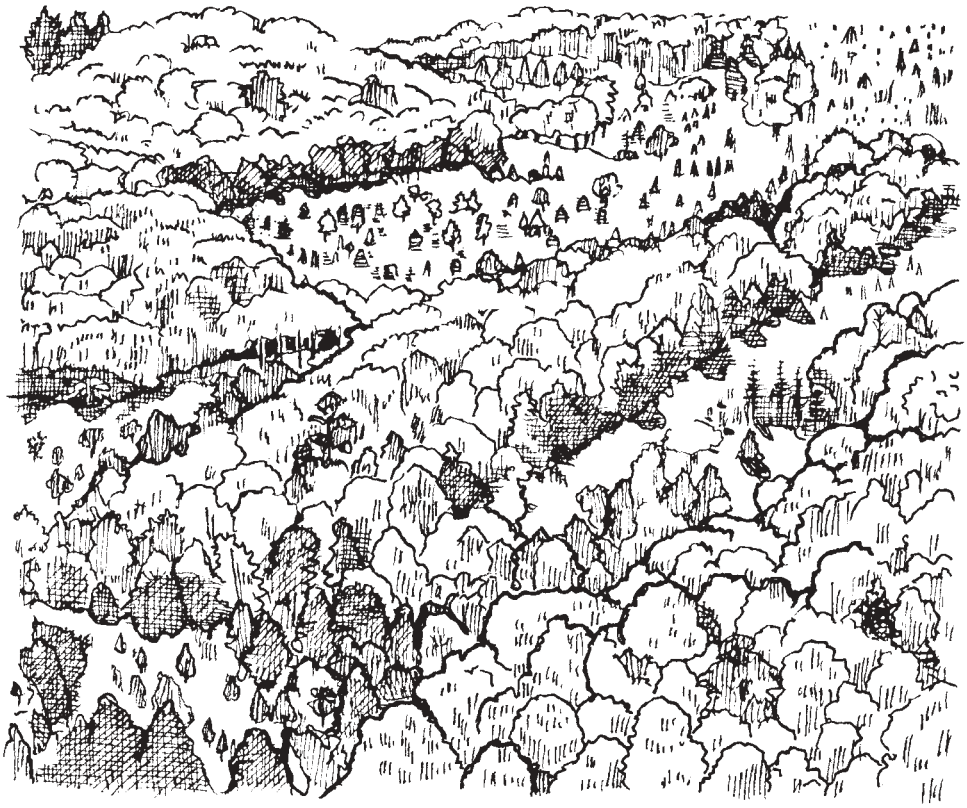
Large trees along a crop field should be deadened, allowing shrubs and small trees to come up in their place.

Aesthetic Considerations

Flowering dogwood

Many management practices affect the appearance of your woodlot. Even though a harvest was beneficial to the health of your forest and may not look bad to you because you know its purpose was beneficial, to the casual observer it may not be visually pleasing.

You may want to plan management activities with an eye toward aesthetics for yourself and because uninformed observers, who do not know the biological or economic factors that influence your decisions to harvest or regenerate trees, may wrongly judge your land stewardship by the appearance of your property. The future of some management practices may be influenced, possibly regulated, as a consequence of public pressure to maintain attractive woodlands. Below are some suggestions to help maintain the visual qualities of your woodland.



When harvesting timber in large areas, create natural-looking stand boundaries by making openings with free-form shapes and curving edges that follow natural topographic features and vegetative changes. Feather edges to create transitions in height and density.

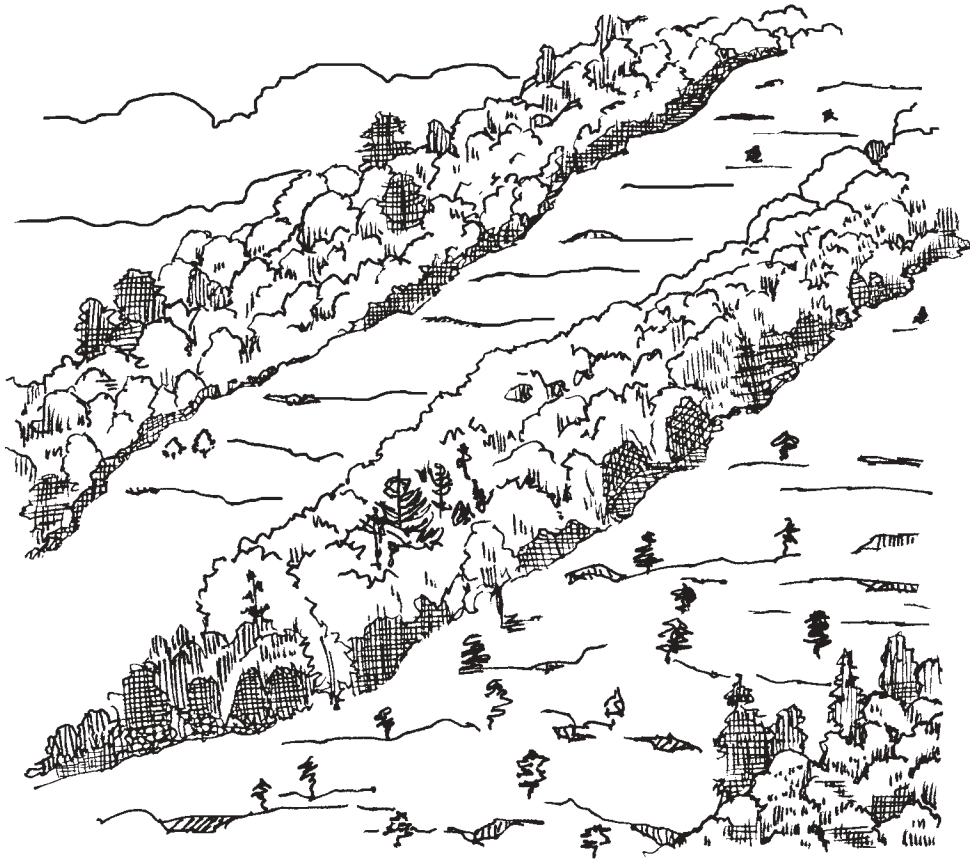
Landscape management

- Create a more interesting landscape by having a mixture of ages and sizes of trees.
- On high points, create scenic vistas by felling trees in the foreground or by pruning lower limbs.
- Close to roads clear sight lines to rock outcrops, streams, lakes or other scenic spots.
- Encourage species with special visual appeal, such as spring flowers, fall color, interesting bark or colorful fruit.

Timber harvesting

- In visually sensitive areas, use uneven-aged management.
- Vary the size and shape of regeneration openings according to the scale and appearance of the surrounding landscape. Locate openings randomly with variable distances between them.
- Create natural-looking stand boundaries by making openings with free-form shapes and curving edges that follow natural topographic features and vegetative changes.
- Soften large openings and add visual variety and wildlife benefits by:

  ✓ Identifying and protecting special vegetation to be left on the area before harvesting.



Avoid ridgeline notches and unnatural looking stand boundaries as in the above example.

- ✓ Leaving groups of trees, flowering trees and shrubs.
- ✓ Extending fingers of vegetation from adjacent stands.
- ✓ Leaving groups or islands of vegetation, rather than single, scattered trees.
- ✓ Retaining groups of pine and/or cedar to provide variety during the dormant season.
- ✓ Avoiding notch-like openings on ridge lines.
- ✓ Clumping snags and den trees for wildlife with other vegetation in the foreground, or leave them along edges. Avoid leaving evenly distributed single trees in the foreground.
- Soften the sharp contrast by feathering edges. Partially cut stand borders to create a transition in height and density between cut and uncut stands.
- Harvest during the dormant season to reduce the number of dead leaves hanging in cut tops.
- Design roads and landings carefully to keep construction to a minimum. Seed to reduce erosion and undesirable soil color contrasts.
- Chip, lop and scatter slash, or keep it low to the ground to improve appearance and encourage rapid decay. Fell dead, dying, broken and leaning trees in the foreground to reduce unsightliness.

Regeneration

- Choose a harvesting method that encourages natural regeneration.
- Plant trees in straight rows only when necessary for maintenance; otherwise plant at random spacings for a more natural appearance.
- Plant a mixture of trees rather than a single species.

Improvement practices

- Use cut trees for firewood to reduce the amount of debris left on the ground.
- In visually-sensitive areas, slash tops and pruned branches low to the ground.
- Leave deadened trees standing. They will fall over a period of years.
- Deadened hardwoods will be less noticeable if treated during the dormant season.

Marketing Timber


American hazel

Selling timber can be a rewarding experience for some forest owners while a traumatic experience for others. Landowners who do a thorough job of planning and marketing are usually satisfied with a timber harvest. Those who did not prepare for a timber sale are likely to be dissatisfied. Many people receive a fraction of their timber's true value because they do not know what they have or do not know how to sell it.

Define your objectives

A successful timber harvest begins with identifying your objectives. This can best be done with a written forest management plan that identifies your objectives, steps to achieving them and times when activities will be carried out. The plan also should identify the type of harvest to be conducted and steps to be taken for reforestation after the harvest.

You need to tell the log buyer exactly what you expect from the timber sale. This is best done through provisions written into a timber sale contract. For example, if one of your objectives is maintaining water quality, a provision in the contract should state that Best Management Practices, which are outlined on pages 56-59, will be followed during road building, stream crossing and harvesting.

Why harvest timber

Other than for financial gain, timber harvesting is a tool for accomplishing objectives that you may have identified in your forest management plan. Such objectives may include:

- Improving the overall health and vigor of the forest
- Promoting seedling regeneration
- Creating wildlife habitat
- Reducing the density of an overcrowded forest
- Establishing planting areas
- Creating vistas and trails
- Developing certain types of recreational activities
- Salvaging damaged or diseased trees.

Steps to selling timber

When selling timber, the following steps should help you get the most financial gain, while protecting the forest resource.

Step 1: Know what you have to sell

Before advertising a timber sale, you first need to determine what you have to sell. This involves selecting the trees to be harvested and determining what volumes and products are present in those trees. Make sure the trees are, in fact, on your property. Settle any boundary disputes with your neighbors before you sell any timber. Clearly mark the trees to be harvested so the logger can easily see them. Mark each tree with a spot of paint about chest high (bright blue or orange works best) on the side of the tree visible from a main trail or road. A second spot of paint should be placed at the ground line. This paint spot will remain after logging to serve as a check to make certain that only marked trees were harvested.

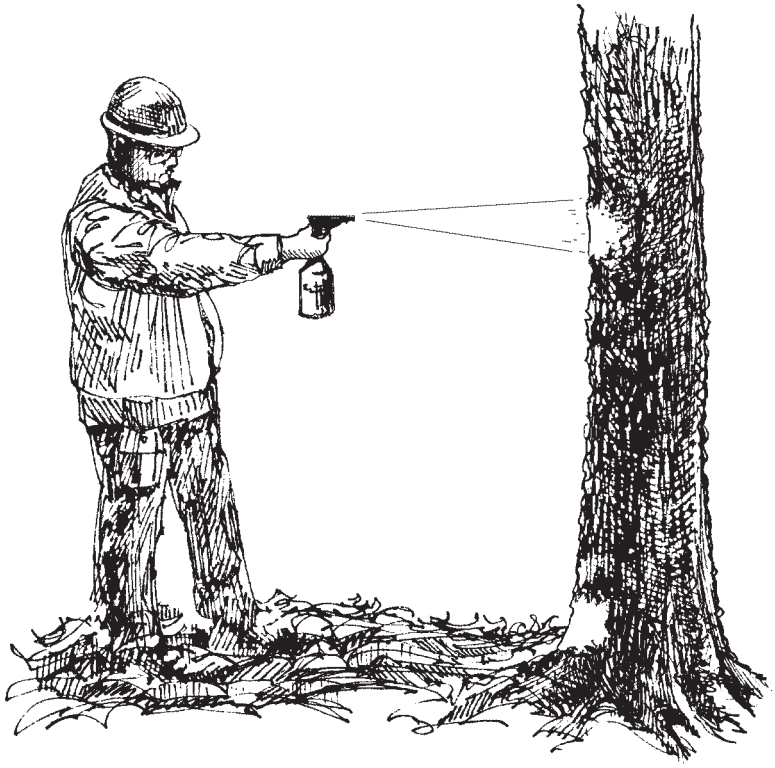
After selecting the trees, estimate the wood volume or the number of products that will be cut by species. Timber volumes are estimated by measuring individual trees. For more details, see Appendices 7-9.

Some common products that may be produced from trees include sawlogs, stave bolts to make barrels, veneer logs, firewood, pulpwood to make paper, posts and poles. These products are determined by the species, size and quality of your timber and can vary greatly in price. There may not be a market for all these products within any given area. Local mills will determine the specifications for each product they purchase. For current market conditions, "Timber Price Reports" are available from a Conservation Department forester or from the Department's web site at www.conservation.state.mo.us/forest/.

Step 2: Determine what your timber is worth

The price paid for standing trees before they are harvested, which is called stumpage, has no set value. Your timber is worth whatever you and the buyer agree to. Many factors influence the price of standing trees. These include:

- *Tree species.* Wood from some species is more valuable than wood from others.
- *Tree size.* Large trees will have more volume and clear wood than smaller trees.
- *Tree quality.* Trees with fewer defects, such as branch scars, decay and imbedded wire, have higher quality, more valuable wood.
- *Volume of sale.* Large volume sales will bring a higher per unit price than small volume sales.
- *Distance to the mill.* The closer a woodlot is to the mill, the lower the hauling costs.
- *Site accessibility.* The ease with which the forest land can be reached affects costs.
- *Logging difficulty.* Steepness of terrain and soil moisture conditions affect the equipment that can be used and the speed of harvesting.
- *Market conditions.* Poor markets mean lower timber prices. Buyers often pay more for logs when their inventories are low to ensure continued mill operation.
- *Your restrictions on harvesting and skidding techniques.* Restrictions set forth in your timber sale contract, such as seeding skid trails after harvest, will increase logging costs.



Mark the trees you want cut by spraying a spot of paint near the ground line and another spot about chest high.

Different buyers may offer substantially different prices for the same timber, depending on their own particular costs and markets. The only way to determine what your timber is worth is to offer it for sale on the open market and contact as many potential buyers as possible.

Step 3: Determine a selling method

Selecting the appropriate selling method for marketing your timber is the key to having a successful timber sale. The two methods commonly used in Missouri are sealed bid and negotiation.

The sealed bid sale is recommended most often for private woodland owners. This process informs potential buyers about the timber sale. These buyers are allowed a length of time—usually four to six weeks—to inspect the trees and submit

bids. Each bidder is allowed to make only one bid and late bids always are rejected. Bids are then opened at a specified time and place, and the successful buyer is selected.

If no bids meet your minimum requirements, you have the right to refuse all bids. No further price negotiations should take place after a buyer has been selected and unsuccessful bidders notified that the timber was sold. See Appendix 4 for a sample bid solicitation.

A negotiated sale involves face-to-face discussions between the seller and a single buyer. This procedure often results in a price well below what the timber is worth because the buyer has no competition and the seller is often uninformed about the timber's value. For that reason, do not be too anxious to accept the first offer for your timber. A negotiated sale, however, may be the best method if:

- You have a small amount of timber or poor quality timber to sell.
- Markets for the species and products for sale are so poor that few buyers would be interested.
- You want to work with a particular buyer that you know and trust.
- You are marketing certain specialty products.

Step 4: Figure out the payment method you want

There are two methods of payment available to woodland owners who sell timber.

In a lump sum sale you receive a single payment for the trees to be sold before the harvest begins. Splitting payments for each cutting area may be necessary for large sales. Payment is based on the amount of timber volume estimated and not the actual volume harvested. Lump sum sales, therefore, depend heavily on the accuracy of your estimate of the volume and quality of timber for sale.

An advantage of a lump sum sale is simplicity. The landowner is relieved of the burden of keeping track of the volume of timber being harvested, and income is provided before harvesting begins. A disadvantage is that the seller receives bids that are based on an estimate of the volume to be harvested, which may be different from the amount actually harvested.

In a yield sale the landowner is paid a certain amount for each unit of product cut. This type of sale also is called selling "on scale." It requires that someone, usually at the mill, scale the volume of products after harvest. An advantage of a yield sale is that the landowner is being paid for the timber that is actually being harvested. The disadvantage is that problems can arise in obtaining an accurate tally since tracking the logs is difficult once they leave your property.

Step 5: Advertise your sale

There are several steps to follow in preparing a timber sale notice. You must have accurate, reliable information, and you need to send it to as many prospective bidders as possible. An up-to-date "Log Buyers List" is available from a Conservation Department forester. A timber sale notice should include the following information that will later become part of the timber sale contract.

- Your name, address and telephone number.
- Location of the timber for sale. Include a map, legal description and directions.
- Description of the trees or logs to be sold. Include volume by species, number of trees, diameter classes and sawlog grades if appropriate. Describe how the trees and sale boundaries will be marked.
- Type of bid you are expecting: lump sum or yield sale.
- Times when potential buyers can visit and inspect the timber.
- Date, time and place written bids will be opened. Include how the successful bidder will be selected and notified.

Red buckeye

- Whether or not a down payment is required to bind the offer when the contract is signed. An amount of 5 to 10 percent of the bid price is normally required.
- Any limitations or special ownership considerations on the sale. Such considerations include: harvesting deadline; restrictions on access; conditions when loggers cannot operate, such as wet conditions; streamside management zones; or buffers.
- Requirements for a performance bond. A performance deposit is an amount of money above the sale price (usually 10 percent of sale price) posted by the buyer when the contract is signed and held in escrow by the seller. The bond's purpose is to ensure that the buyer abides by the terms set forth in the contract. The performance deposit should be refunded immediately after the sale is completed and contract requirements are met.
- Statement whether the logger must carry insurance and liability. Insurance will avoid possible legal complications if a logger is injured on your property, and liability insurance will cover any damage to your property or adjoining lands caused by the logger.
- Statement indicating your right to reject any or all bids.

Step 6: Draw up a timber sale contract

The purpose of a timber sale contract is to protect the interests of buyer and seller and must be signed by both parties. To reduce the possibility of misunderstandings, you should meet with the logger or buyer to discuss the items to be included in the contract.

The written contract does not need to be complex, but it should reflect what you and the logger have agreed to with respect to the sale. Timber buyers will frequently provide their own standard contract. Such contracts may not adequately represent your interest as a seller. See Appendix 5 for a sample timber sale contract.

You may want to have a lawyer draft or review your contract. It is critical that you include the provisions that you feel are important regarding the harvest on your property.

Step 7: Supervise the timber harvest

One of the most important things you can do during the harvest is to inspect it periodically. Before harvesting begins, review the timber sale contract with the logger and point out sale boundaries. If possible, walk the site to be harvested with the logger. This will accomplish two objectives: 1) It will give you an opportunity to get to know the logger, and 2) It will give you a chance to explain your objectives of harvesting timber. A logger who is familiar with you and aware of your objectives will likely do a better job.

Once timber harvesting begins, visit the area frequently. When you visit the site make sure that logging meets the terms of the contract. Questions that arise should be discussed with the logger. Unless you discover a flagrant violation of the contract, a simple suggestion to the logger in charge of the operation usually will solve any problem. After the harvest is completed and all provisions of the contract have been fulfilled, write a letter releasing the buyer from the contract and return the performance deposit.

Step 8: Practice good forestry

Improper logging practices can have adverse effects on water quality, wildlife and forest regeneration. To ensure that you are satisfied with the end result of the timber harvest, it is important that good forestry practices are applied during and after the logging operation. Following the Conservation Department's best management practices and having a reforestation plan are two important considerations for harvesting timber on your property.

Best Management Practices


American elm

In Missouri forests, most water quality changes associated with management practices are from the access roads and harvesting. Soil losses and sediment due to silvicultural activities generally occur when the protective litter layer is disturbed. Water from undisturbed forests is high quality because the canopy and litter layer protect the soil surface and enhance soil biological activity. With the litter intact, water soaks into the porous soil and rarely runs over the surface.

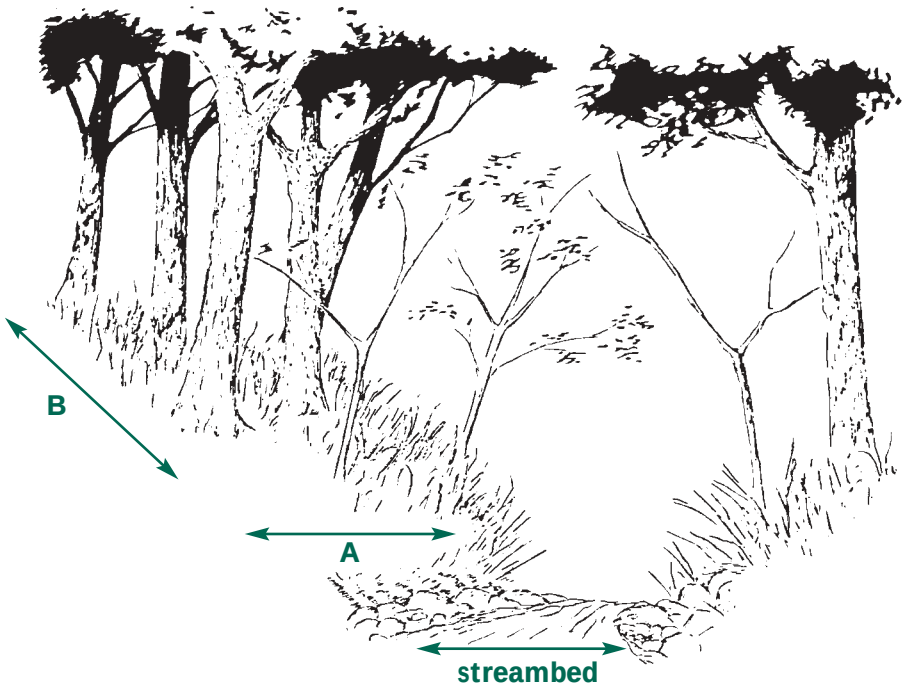
Without this protective layer, however, raindrops detach soil particles and start eroding, transporting and depositing sediments. Dislodged soil particles wash into soil pores, decrease soil porosity and overland flow starts. Soil porosity also is reduced by compaction from heavy equipment, especially when soils are wet.

The following are recommended best management practices to protect water quality while conducting forestry operations. More detailed recommendations can be found in "Missouri Watershed Protection Practices," which is available from the local Conservation Department forester.

Streamside zones

Streamside zones are the areas adjacent to perennial and intermittent streams, caves, springs and lake. They are important to maintaining stable streambanks, and trapping sediments and pollutants before they enter the water. Streamside forests slow flood waters and provide shade to streams, moderating water temperatures. The deep moist soils provide sites that have the potential to grow individual high-quality trees. Streamside zones need special protection during management operations to maintain water quality.

Streamside zones are separated into two parts. The primary streamside zone is 25-foot wide strip measured from the top of the streambank on both sides of the stream. The secondary streamside zone is variable in width and is based upon twice the slope percent of the surrounding land plus the 25-foot wide strip. If the slope of the land up to the streambank is 10 percent then the width of the secondary zone is 45 feet (10 x 2 + 25). This width extends from the primary zone on both sides of the stream.



When managing a forest along a streambed, use the correct techniques for each zone: (A) primary streamside zone and (B) secondary streamside zone.

Primary zone recommended practices

- Harvesting operations should leave a residual stand of trees of at least 60 square feet of basal area. See Appendix 11.
- Cable out logs cut during harvesting.

- If a streamside forest is lacking, direct seed or plant to establish one.

Practices to avoid

- Use of wheeled or tracked vehicles within 25 feet of the streambank
- Leaving trees or tops in the water
- Building roads within 25 feet of the bank, except at stream crossings
- Wildfires
- Any operation that exposes bare soil, except for tree planting
- Portable sawmills, log decks or log landings
- Any use of pesticides not labeled for use near water
- Livestock grazing.

Secondary zone recommended practices

- Harvesting operations should leave a residual stand of trees of at least 60 square feet of basal area. See Appendix 11.
- Use wheeled or tracked vehicles carefully to avoid erosion and tree damage.

Practices to avoid

- Building roads or trails unless necessary for stream crossings
- Portable sawmills, log decks or log landings
- Any operation that exposes bare soil, except for tree planting
- Leveling gullies, unless immediately seeded and mulched
- Any use of pesticides not labeled for use near water
- Livestock grazing
- Wildfire.

Stream crossings

Because an increase of sediment is common at stream crossings, road building and vehicle travel across streams should be avoided whenever possible. In most cases, advance road planning will reduce or eliminate the number of stream crossings necessary.

Recommended practices

- Plan the location of roads to minimize the number of stream crossings.
- Install properly sized culverts where permanent logging roads cross streams.
- Locate crossings at right angles to the stream channel, where the bottom is hard and relatively level.
- Protect permanent crossings with coarse rock.
- All approaches to crossings, whether temporary or permanent, should be at gentle grades.
- Soil around culverts, bridges and crossings should be stabilized with coarse rock.

Practices to avoid

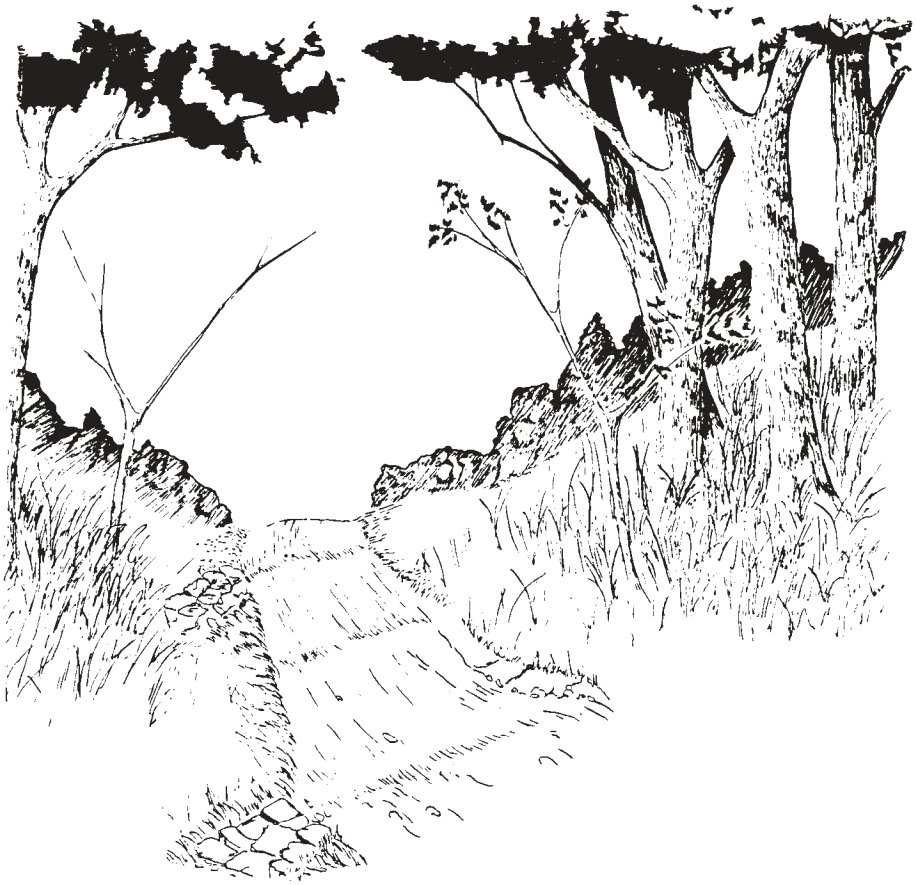
- Temporary crossings of logs and brush topped with soil
- Any practice to alter the flow of the stream.

Access roads

For most harvesting operations in Missouri, the construction of special logging roads is not required. Usually the main haul road is a county road. Nearly 90 percent of the erosion from timber harvests comes from the road system. Soil loss from road construction and use is similar to losses from tilled crop fields.

Recommended practices

- Roads should be located and constructed to provide adequate water drainage from the surface. Locating roads along the contour should result in gradual grades.
- Locate roads above flood plains and wet areas.
- Road grades should be less than 8 percent, except where terrain requires short steep grades.
- Construct roads with gradual curves that are wide enough for efficient operation of heavy equipment. The road bed on temporary roads should be 12- to 14-feet wide.



A protected road through a wooded area should have a water bar at the top of the grade and stone riprap at diversion outlets. The cut banks should be seeded as necessary.

- Surface roads with gravel where necessary to support heavy equipment and to protect the road from erosion.
- Keep roads free from logging debris that prevents the flow of water from the road surface.
- Pile cleared debris on the lower side of fill slopes to restrict soil movement.
- Use culverts where needed to route water under the road for proper drainage.
- Broad base dips should be located at the proper intervals to channel water across the road. The dips should be outsloped about 3 percent and surfaced with large rock.
- Water bars should be used when retiring temporary roads and main skid trails.
- Roads constructed within streamside zones should have all exposed soil immediately seeded and mulched.
- Water turnouts should be constructed to divert water from road ditches.
- Shape, cut and fill slopes, then seed and mulch to stabilize.
- Retire temporary roads by reshaping, building water bars, then seed and mulch.

Practices to avoid

- Construction of roads in streamside zones where possible
- Using roads when soils are wet
- Locating roads in stream beds.

Timber harvesting

Missouri timber harvests typically involve small acreages and do not require extensive road construction for access. Vegetation responds rapidly after a harvest to stabilize exposed soil. Studies of managed forests show that soil erosion occurs at about the same rate as naturally occurring geologic erosion. Timber harvesting activities pose little threat to water quality when care is taken to prevent erosion.

Recommended practices

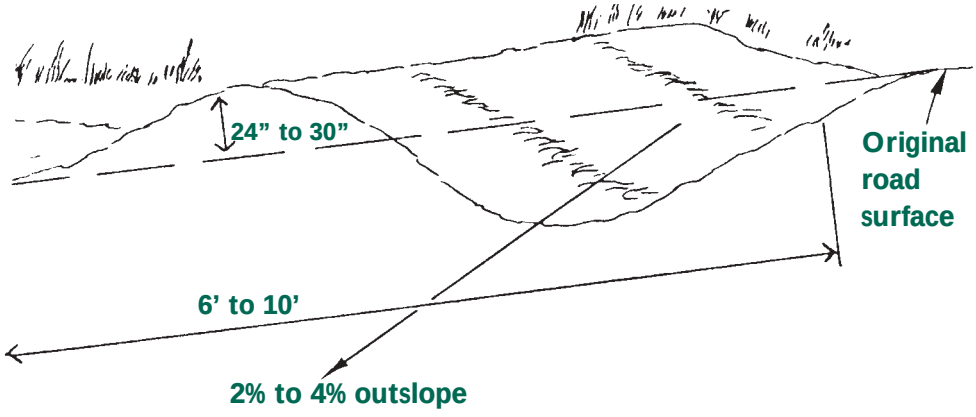
- Follow the practices for streamside zones, listed on pages 56-57, when harvesting in these areas.
- Locate log landings on stable soils and so skidding is directed away from the stream.
- Log landings should be no larger than necessary.
- Seed landings when logging is completed.

- Portable sawmills should be located away from any body of water.
- Provisions should be made at lunch areas and portable sawmills for disposal of human waste and trash.

Practices to avoid

- Changing oil in equipment on the logging site. If machinery is serviced in the forest, collect the oil for proper disposal.
- Disposal of logging debris in streams and lakes
- Temporary crossings made from logs piled into streams.

Broad base dips should be located at the proper intervals to channel water across a road. The dips should be outsloped about 3 percent and surfaced with large rock for adequate drainage. Plant grass seed next to the road as necessary to stabilize the soil.



When all forestry practices are completed, temporary access roads should be retired by reshaping, seeding and mulching in combination with the use of water bars, shown above.

Special Forest Products


Red mulberry

As a forest owner you can enjoy annual income from your woodlands and still manage for high quality sawlogs and wildlife habitat. In recent years there has been more interest in non-traditional items that nature produces in and around forests every year—potential products that can be marketed for annual income.

Pollen

Tree and shrub pollens of many species are harvested in hardwood stands beginning in early spring when flowering starts. Generally, pollens are harvested by "producers" who pick the flowers when the pollen is "ripe." They contract in advance with landowners for pollen harvesting rights.

Prices for raw pollen vary from about $1 per gram for the most common species to more than $20 per gram for species that produce little pollen or occur in a limited range. Prices vary from year to year, but pollen processors distribute price lists containing the species they want and the approximate amount they are willing to pay for material meeting their specifications.

Berries and Fruits

Blackberries, blueberries, gooseberries, huckleberries, wild strawberries, wild grapes or mulberries grow under a forest canopy. Landowners might allow people to pick wild berries for a fee or pick them themselves and sell the fruit to individuals or local businesses for further processing.

Persimmons, pawpaws, chokecherries and crab apples are used for specialty jams and jellies, confections and baked goods. May apples and crab apples are used in jellies and preserves as well as medicinal compounds. People are growing natural varieties of pawpaw, sometimes called the "Ozark banana," for more consistent fruit production, larger fruit size and smaller seeds. The pulp of the fruit is high in vitamin C. The twigs and leaves contain compounds used as natural pesticides and anti-cancer medicines.

Edible Nuts

Black walnuts have been the major nut crop in Missouri for many years. In an average year Missourians deliver more than 20 million pounds of nuts to local hullers. Most of this volume comes from wild trees and is delivered to market by landowners. For walnuts delivered to the huller, producers are paid about $10 per hundred weight after the green outer husk is removed.

Native pecans also are collected and sold, most of them directly to consumers at roadside stands or to commercial processors.

Managing native pecan stands for nut production is increasing, but the market is still open. Many of the "minor" nut species also have good markets. Hickory markets are expanding in the South and Midwest. In addition, the demand for butternut, chestnut and hazelnut normally exceeds supply.

Acorns are often overlooked as edible nuts in this country, but they have future potential in international markets, especially along the Pacific Rim. Other edible products of forests include honey, mushrooms, maple syrup, herbs, spices, edible roots and flavorings.

Cones and Seeds

Cones offer a variety of market possibilities. The most obvious markets for ripe cones are tree nurseries throughout the country. Cone harvest often takes place in conjunction with a timber sale timed to when the cones are ripe. Cones can then be easily picked from the tops after cutting the tree.

Cones that have opened also are in demand for various floral, wreath and potpourri products. Many nurseries now sell opened cones to craft markets. Almost any species of cone, from small fir cones to large ponderosa pine,

are marketable. Cones are most often sold by weight but may also be sold by the bushel or be individually priced for large or unusual specimens. Prices average 30 to 60 cents per pound.

Hardwood seed crops can be handled in a similar manner. The market is growing for seed of both tree and shrub species for native plant nurseries. Seeds from understory plants and shrubs are equally desirable, and seed from medicinal plant species may be marketed as grown in a cultured environment. A thorough inventory of all your forest plants would be a good idea to determine if you have potential for harvesting multiple seed crops.

Prices vary according to relative abundance of the species and the difficulty of harvesting the seed. Price lists are available from larger seed dealers and seed supply wholesalers. Landowners can harvest seed themselves or sell harvesting rights to a seed collection company.

Seed production is variable, even in local areas. For consistent income, landowners should focus on several different species and become familiar with the seed production requirements for each. You also should check special state regulations regarding the species being harvested, although there are few restrictions for harvesting on private land.

Decorative Wood & Horticultural Products

Unusual parts of trees, such as burls, conks, shelf fungus and dwarf mistletoe-infected branches, can be sold in most areas of the country. Distorted grain patterns, colors and textures lend appeal to wood turnings, veneer, carvings or sculpture.

Diamond willow walking sticks made from willow infected with canker are popular. In Missouri, oak, hickory, willow, redcedar, walnut, sassafras and sumac are harvested for walking sticks when 1 to 1.5 inches in diameter. Wholesale prices average $1 to $2 per 3- to 4-foot stick.

Cypress knees, fruitwood grafts, pine knots, knot holes and limb crotches can be marketed through hardwood lumber outlets, carving shops and specialty wood supply houses. A few specialty wood supply catalogs also list a variety of these products. Horticultural supply companies occasionally stock this type of material for bouquets, floral arrangements, bases and other products.

With bark still attached, oak, hickory and elm sticks in a diameter of .5 to 1.5 inches are used by manufactures of bent-wood or rustic furniture. Fresh 4-foot sticks sell for approximately 50 cents each. Longer sticks—up to 10 feet long—sell for more. Eastern redcedar also is used for similar products.

Burls, figured wood, spalted wood or woods of unusual color also are in demand for turnings, wood pens, furniture panels, veneer and many other specialty uses. These are items that are relatively scarce and highly desirable; therefore, it is not uncommon for them to be sold individually.

Spalted wood usually develops in logs or trees that have been lying on the ground long enough for the decay process to begin. Spalting usually occurs in the sapwood portion of the tree, leaving the heartwood still usable for lumber or other solid wood products. Old log decks sometimes are a good source of spalted wood.

Medicines & Pharmaceuticals

Medicinal compounds used for naturopathic remedies include a large number of herbs used to make teas and oils. These markets are well established and growing. Manufacturers of pharmaceutical drugs also require specific chemical compounds contained in plants and trees. Wild crafting or gathering these plants has historically provided income for many rural families.

Pharmaceuticals are not the only use for many of these plants.

Some dyes, cosmetics, fungicides and insecticides also are derived from relatively common plants. Several botanical companies with headquarters in Missouri purchase and market botanical plant material throughout the world. All regularly publish price lists and specifications for the plants or plant parts they purchase.

Some of these plants are relatively rare and may actually be listed as rare or endangered. Landowners are advised to become familiar with harvesting regulations that might be applicable if these plants are marketed.

Bark

Bark is used for medicinal and "natural" food supplements. Cottonwood bark is prized by wood carvers, who cut faces and caricatures from the thick plates. It is also used for bases for floral arrangements and crafts. It is softer than wood, but dense enough to maintain detail. Pieces 3 to 4 inches wide, 10 to 12 inches long and 2 to 3 inches thick sell for $5 to $15 at craft and carving shows. Bark with distinctive patterns (such as hackberry, winged elm, persimmon) or color may have a market in your area. The problem with harvesting bark products is that it usually kills the trees.

Recreation

The old real estate adage of "location, location, location," certainly is true here. If your land is located near population centers, your options are probably greater than if it is in a remote area. Remoteness, however, is a commodity that also can be marketed.

Fee hunting and fishing have been sources of income in some areas of the country for many years. Urban families are willing to pay for places to enjoy nature photography, harvesting wild edibles, farm vacations, hiking, camping, picnic areas and bird watching.

Allowing people access to your private property is not without risk. Liability insurance rates vary widely for recreational enterprises.

For more information

There are thousands of potential forest products—only a few are named here. For the innovative landowner or entrepreneur, however, these brief descriptions will point the way to specific products and markets.

To begin your research, see Virginia Tech's Non-Timber Forest Products web site at www.sfp.forprod.vt.edu/.

The "AgriMissouri Buyers Guide," a publication of the Missouri Department of Agriculture, lists many processors and canners and markets for a wide variety of wild-crafted products. This publication is as an excellent reference for landowners attempting to find existing markets for many special forest products in their local area.

Tax Considerations


Osage-orange

Note: The information in this section is for general educational purposes only, and in no way is intended to substitute for legal counsel. Such advice, whether general or applied to specific situations, should be obtained from your personal tax counsel.

How to determine your timber basis

Basis is a way of measuring cost or investment in timber and other assets. It is used to figure amortization for new tree plantings, depletion when the timber is sold or disposed of, the deduction for depreciation and casualty loss.

The initial basis, or book value, of timber should be established at the time it is acquired. Whether property is received by purchase, gift or inheritance, its value often includes land, buildings or other assets in addition to timber; and the basis of the timber must be separated from the basis of the other assets. When the timber is sold, gain or loss is determined by comparing the timber's adjusted basis to its sale price.

At the time of purchase, basis can be established from allocating the share of value for timber providing the price paid was fair market value. The fair market value of the assets should not be determined by guesses but by knowledgeable individuals, such as consulting foresters or appraisers. If the timber contains a mix of high-value and low-value species of merchantable size, consideration should be given to establishing separate cost bases for each type. This will allow the investor to recover the basis in the timber in proportion to the income received from each type of timber.

The amount entered as basis when an asset is acquired depends on how the property was acquired. Below are examples of several common methods of acquiring property.

- *Purchase*—The basis of property is usually its cost. This cost may include not only the purchase price but also real estate taxes, closing costs, attorney fees, surveying, timber cruise and any other costs directly associated with the purchase.
- *Gift*—If property is received as a gift, basis to the new owner usually equals the donor's adjusted basis at the time of the gift, plus the amount of any gift tax paid on the gift. This total, however, cannot exceed the fair market value of the property at the time of the gift.
- *Inheritance*—Your basis in property you inherit is usually its fair market value at the date of the decedent's death. In many instances, the fair market value is usually greater than the adjusted basis to the decedent. A special provision in the law permits a "stepped up" or adjusted basis to market value when property passes through an estate.

Forest property typically includes several assets, such as roads, fences, buildings and timber. Separate capital accounts should be established for the depreciable assets so they can be depreciated. Annual depreciation deductions permit the owner to recover basis in this type of property. Sales contracts and deeds usually do not list values for land, timber, buildings and other assets because they are purchased as one unit. Thus, the purchaser must allocate portions of the total purchase price to each item included in the unit. The part allocated to depreciable assets is recovered through depreciation. Depletion provides recovery of the share of purchase price allocated to timber. The part of basis allocated to land is recovered only when the land is sold.

Determining basis after property is acquired

The best time to establish a basis for timber is when the property is acquired. However, it can be done at a later time if certain information is available. Woodland owners who acquired their timber many years ago and have not established a basis for the timber may find that the cost to deter-

mine the basis may now exceed the basis. Generally speaking, the larger the timber tract and the more valuable the timber, the further back in time it will pay to determine the basis. This is, however, made on a case-by-case basis.

Timber volume

The taxpayer is required to estimate, with respect to each separate timber account established, the total units (board foot measure, log scale, cords or other units) of timber on the date of acquisition of the property. If inventory records do not exist, it is necessary to use forest inventory techniques to "grow" the present forest in reverse to the date of purchase. This is a relatively easy task for a professional forester if no cutting has taken place since the time the property was acquired. If cutting has occurred and records of the volume cut are not available, it may not be possible to make the estimate.

Timber value

After the volume by type is estimated, the fair market value of this timber on the date of acquisition must be estimated. The best available evidence of timber values on this date must be used. Ideally, the price actually paid for timber similar in character and quality in the location of the subject property on or near the valuation date should be used. Foresters who have been practicing for many years may have such data in their records. Timber buyers also may be willing to provide such information. Otherwise, published price reports may be used if the average prices are adjusted to reflect differences between averages and the particular timber in question.

Additional adjustments required

In addition to the fair market values for the assets as of the date of acquisition, it also is necessary to determine the volume of timber disposed of, if any, since the acquisition. This is because the basis must be reduced by the basis allowed for any previous sales, even if the basis was not claimed on the tax return for the year of the sale.

Natural regeneration

If you purchased land without trees or with a few trees and, therefore, no basis in timber, but through natural regeneration you have established saleable timber, your basis in the timber is zero. This is because you have no cost in the timber establishment. If you planted trees, your basis is the cost of planting including seedlings and site preparation.

Adjusted basis

Adjusted basis is the adjustment, either upward or downward, of the timber basis or account to reflect changes. The adjustments should be made in terms of dollar amounts and volume of timber in the account.

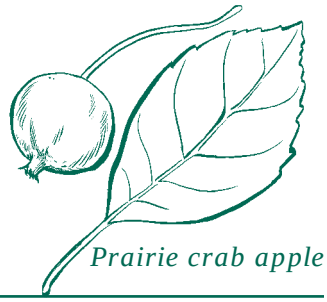
Items that would increase the timber basis would be acquisition of additional timber and capital improvements and carrying charges, such as timber stand improvement, fertilization and pruning.

These capital improvements and carrying charges can only be added to the basis if they were not expensed or deducted yearly. Likewise, those costs that would decrease your timber basis would be depletion resulting from the sale of timber, amounts allowable as a basis of loss for casualty claims and costs allowable as basis of sale.

In addition to adjusting the basis, the timber volume or quantity should be adjusted to reflect the increase (from acquisition) or decrease (from sale or casualty loss). These adjustments to basis should be made annually at the beginning of the tax year.

Tax treatment from timber sales

When reporting income from the sale of timber, the woodland



Prairie crab apple

owner must determine the dollar amount and the type of gain or loss.

Determining amount of gain or loss

The amount of gain or loss in a timber sale is determined by reducing the amount received from the sale by the basis of the timber and the timber sale expenses.

Timber sale expenses

Timber sale expenses are those costs associated with preparing and offering timber for sale. Examples of timber sale expenses are marking timber, cruising, advertising and paying for professional services directly related to the sale.

Basis

For purchases, the basis is the allocated amount paid for the timber, plus additional costs such as seedlings and associated costs of planting. If the acquisition was inherited, the basis is the fair market value or the special use value that is reported on the federal estate tax return.

Generally, gifts take the donor's basis. If the gift is taxable, the basis is increased to include any gift taxes paid but not above the fair market value. When the timber is eventually sold, there will probably be a gain from the sale.

The gain is obtained by subtracting the basis of the timber sold and any other expenses directly related to making the sale. If only part of the timber is sold, the cost basis must be allocated or spread against the total timber potentially for sale. The allocation of basis is called depletion. Thus, basis is the dollar figure that one has to subtract; depletion is the method used to describe the recovery of basis.

Depletion unit

The depletion unit is the basis amount per unit (tree, cord of wood, board feet, etc.) in the timber account. It is obtained by dividing the adjusted basis by the available quantity of timber.

For example, the cost of planting 4,000 trees is $2,500. The depletion unit per tree is 62.5 cents/tree; 2,500/4,000 = 62.5 cents.

As another example, assume the cost of timber when land and timber are purchased is $10,000. It is estimated there are 100,000 board feet of marketable timber at time of purchase. The depletion unit of the marketable timber at time of purchase is 10 cents per board foot, or $10,000/100,000 = 10 cents.

Example 1: An individual purchased a 150-acre farm in 1999 for $200,000. A timber cruise prior to purchase revealed that 100,000 board feet of marketable timber were on the land with a value of $10,000.

The values placed on various assets when the farm was purchased were as follows:

Land $175,000
(basis of land)

Depreciable assets $15,000
(basis of depreciable assets)

Marketable timber $10,000
(basis of timber)

Total purchase price . .$200,000

The timber was clear cut and sold later the same year for $13,000. Costs related to the sale were $250. Below are calculations of gain from the sale:

Sale proceeds $13,000

Less sale expenses $250

Gross sale price $12,750

Less timber basis $10,000

Gain from sale $2,750

Example 2: The same individual decides to do a selective cut. When less than the entire tract of timber is sold, adjusted basis must be determined for the quantity sold. This is accomplished by calculation of the depletion unit.

The depletion unit is computed by dividing the adjusted basis in the timber account by the total quantity of timber in the account. In 1999, the year the timber was purchased, a sale of 20,000 board feet was made for $4,000. Sales expenses were $200.

The calculation would be as follows:

Year 1

Sale proceeds $4,000

Less sale expenses $200

Gross sale price $3,800

Less basis (20,000 bf x $.10) $2,000

(remaining basis is $8,000; $10,000 - 2,000 = $8,000)

Gain from sale . . . . . .$ 1,800

The $2,000 basis was determined by dividing the original 100,000 board feet purchased into the original $10,000 sale price. Since 20,000 board feet were sold and the depletion rate per board foot is 10 cents, $2,000 of depletion was used.

In the following year of 2000 an additional 20,000 board feet were sold. The total board feet in the woodland just prior to the sale was 81,000, and the annual growth is 1,000 board feet per year. The original 100,000 board feet minus 20,000 board feet sold in 1999 plus 1,000 board feet of new growth from 1999 to 2000 equals 81,000 board feet.

The adjusted basis at the start of this year was $8,000. The depletion unit for Year 2 is $.0987 per board foot or $1,975. This is calculated by dividing 81,000 board feet into $8,000 of adjusted basis to get basis per board foot. Then multiply $.0987 by 20,000 board feet for a total of $1,975.

The key is to divide the total board feet in the year of sale into the adjusted basis.

Year 2

Sale proceeds . . . . . .$ 4,500

Less sale expenses $200

Gross sale price . . . . . .$ 4,300

Less basis $1,975

(remaining basis = $6,025; $8,000 - 1,975 = 6,025)

Gain from sale . . . . . .$ 2,325

In subsequent years, the same method of calculation will be used until the original $10,000 basis is used up.

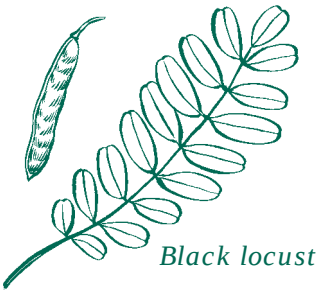
Determining the type of gain or loss

Standing timber is treated for income tax purposes as either a capital asset or a non-capital (ordinary) asset. This distinction is critical in determining whether a timber owner's gain or loss is considered ordinary or capital.

In 1987, 28 percent was the maximum rate at which long-term capital gains could be taxed, while ordinary income of individuals could be taxed at rates as high as 38.5 percent. In 1988 and later, the maximum rate for individuals is 28 percent and will apply to both ordinary and capital gains income. Prior to 1987, ordinary income and short-term capital gains were fully taxable, but only 40 percent of the long-term gains were taxable. In 1987 the 60 percent exclusion rate for long-term capital gains was eliminated.

Under current tax law, the entire gain on a timber sale will be taxed at the same rates that apply to ordinary income. It may, however, still be beneficial to the woodland owner to qualify the timber sales for long-term capital gains. Whether a timber owner's gain or loss qualifies for capital gains treatment depends on three factors:

1. *Primary purpose for holding timber*—Timber is a capital asset if it is neither used in a trade or business or held primarily for sale to customers in the ordinary course of a trade or business. Timber held as an investment by a woodland owner could qualify as a capital asset under Section 1221 of the Internal Revenue Code (IRC). Although timber used in a trade or business is not a capital asset, its outright sale may nevertheless result in a long-term capital gain if the holding period has been met.
2. *How timber is disposed*—A taxpayer may dispose of timber in one of three ways:
   a. *Lump sum*—Standing timber is often sold for a lump sum or fixed amount agreed upon in advance. Assuming sales are infrequent, gain or loss on the sale of timber if owned more than the required holding period is a long-term


Black locust

capital gain or loss.

b. *Pay-as-cut or Economic Interest Retained-IRC Section 631(b)*—Sometimes called a pay by scale, the price per unit is determined in advance, but the amount of timber to be harvested is not. Income from the sale is based strictly on the volume actually harvested. The seller retains an economic interest and legal title to the standing timber until it is cut. In this type of sale, the timber is included within a special tax category of business property identified by Section 1231 subject to capital gains treatment.

c. *Election to treat as a sale*—Timber owners who cut timber for use in their trade or business can, under certain conditions, obtain capital gains treatment by "electing to treat the cutting as a sale." This is the Section 631(a) treatment. In simple terms, the owner buys the timber from himself and then sells it back to his trade or business. If a taxpayer cuts timber owned for more than one year (six months after June 22, 1984, and before Jan. 1, 1988) before the beginning of the year in which the cut-for-sale or use in his or her trade or business and a Section 631(a) election is made, the gain is reported in two parts: 1) The difference between the allowable basis for the standing timber cut during the taxable year and its fair market value as of the first day of the taxable year in which it was cut may qualify for capital gains treatment; and 2) The difference between the fair market value of this timber on the first day of the tax year and the proceeds from the sale of the products produced from the timber cut, less processing costs, is ordinary income.

3. *How long the taxpayer has held the timber* —To qualify for long-term capital gains, the taxpayer must have held the timber for more than one year prior to cutting, unless it was acquired after June 22, 1984, and before Jan. 1, 1988. Timber acquired during that time need only be held for more than six months. However, when cutting under a Section 631(a) election, the timber (or the contract right to cut timber) also must be held on the first day of the taxpayer's taxable year during which the timber was cut. Under prior law, Section 631(a), elections could be revoked only with permission of the IRS. The new law permits revocation upon notice to the Internal Revenue Service.

Capital gain status can still be important

Even though the rate differential between ordinary income and long-term capital gains was eliminated in 1988, capital gains will remain as a separate entity in the federal tax law. Technically, there will continue to be a recognized difference between ordinary income and capital gains.

For example, capital losses may be used to offset only $3,000 of ordinary income per year, but there is no limit on using such losses to offset capital gains. Thus, if a taxpayer has large capital losses from any source, he or she will be able to use a greater proportion of those losses during any year in which that person has capital gains.

Some forest landowners will also be able to avoid paying Social Security tax on timber sale income. This is because gains that qualify for capital gains treatment are not subject to the self-employment tax.

Sale of forest products other than standing timber

Proceeds from the sale of forest products other than standing timber are treated as ordinary income. This includes logs, lumber, pulpwood, poles, mine timbers, maple syrup, nuts, bark,

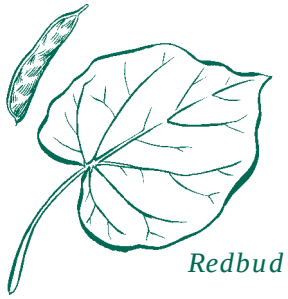
Christmas greens and nursery stock. In addition, income from the sale of firewood or pulpwood produced from the limbs and tops of trees is ordinary income.

Reporting timber income or losses

The timber income or loss and the forms used are determined by the type of taxpayer involved. They include:

- Non-timber business—Timber income or loss incidentally realized other than farming.
  - ✔ Ordinary Income-Form 1040 as Other Income
  - ✔ Capital Gains-Schedule D, Form 1040
  - ✔ Timber income incidental to Farming—Use Schedule F, Form 1040 for ordinary income and Schedule D, Form 1040 for capital gains.
- Timber-related business
  - ✔ Ordinary Income—Use Schedule C, Form 1040 if sole proprietorship
  - ✔ Capital Gain—Form 4797 and Schedule D, Form 1040
  - ✔ Form T is an information return. As a matter of good business practice and record keeping, the appropriate sections of Form T, such as purchases, sales and planting, should be completed routinely by the woodland owner. If you claim a deduction for depletion of timber or for depreciation related to the timber account, you must complete and attach Form T to your tax return. Form T should be filed when a taxpayer sells or cuts standing timber or has a casualty claim.

Where to Find Technical Assistance



Proper management and care of the private forest resource is important to the health of Missouri's economy and environment. Conservation Department foresters can help private landowners manage the natural resources on their property.

The Department offers two levels of assistance based upon the landowner's need and interest in long-term forest management. The two levels are advisory and management.

Advisory Service

Advisory service is available to all landowners, including urban residents. This service includes:

- Group training sessions
- Publications
- Film and video loan
- Office consultation
- Insect and disease identification and analysis
- Referrals to consultants
- On-site visits under certain conditions
- Help with evaluating and choosing land management options.

We encourage owners to accompany the forester during an on-site visit. The landowner must provide the legal description of the land or the street address with the request for assistance.

Management Service

Management service is available to landowners interested in the long-term management of their forest land. Those who receive management services agree to develop and carry out a management program for the immediate and long-term stewardship of their property.

Management service includes assistance in developing and implementing a management plan for the property. Activities in the management plan may include:

- Marking and selling forest products
- Guidance for conducting timber stand improvement work, including harvesting and using wood products for personal use
- Advice on tree planting, including free use of mechanical tree planters
- Pest identification and analysis
- Guidance in wildlife habitat improvement, erosion control, outdoor recreation development, soil and watershed protection, and forest road location and construction.

To receive these services, the landowner must:

- Show proof of ownership with a copy of the property deed or a current tax receipt
- Complete a "Forest Management Questionnaire" provided by the Conservation Department
- Develop and agree to follow a long-term forest management plan for the property.

The Department provides the landowner with:

- An on-the-ground visit to collect forest resource information
- A map or aerial photograph of the property showing buildings, roads, streams, vegetative cover types and other important features
- An interpretation of the resource information and a summary of management options
- Assistance in developing a management program for the property.

Marketing Guidelines

Selling timber is only done occasionally by most private forest owners. Many request the knowledge and aid of a forester in marketing their timber. Conservation Department foresters can help landowners with marking and selling timber under these guidelines:

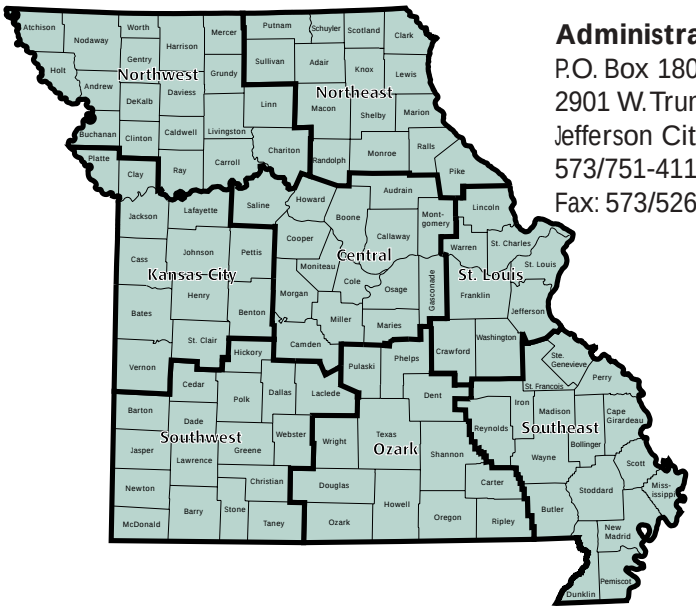
- Provisions under "Management Services" are met.
- Property boundaries must be located and marked on the ground.
- The land must not be listed or advertised for sale.

- The timber sale area is not being converted to a non-forest land use.
- The sale specifications must be within the allowable limits of the management plan.
- The landowner must agree to the terms of a "Timber Sale Assistance Agreement."

Consulting Foresters

Conservation Department foresters are limited in the services they can provide by time and Department guidelines. Some landowners, due to the nature of their needs or its urgency, may wish to hire a consulting forester. These self-employed foresters offer services on a fee or contract basis. Some of the services consultants can provide include value appraisals of forest land, damage appraisals and expert court testimony. For a list of consulting foresters, see the Department web page at www.conservation.state.mo.us/forest/, or contact the nearest regional office. You also can get information from the Missouri Consulting Foresters Association, 2231 Bluff Blvd., Columbia, Mo. 65201. Phone: 573/443-3977.

Missouri Department of Conservation Regional Offices



Administrative Office
P.O. Box 180 (zip 65102)
2901 W. Truman Blvd.
Jefferson City 65109
573/751-4115
Fax: 573/526-6670

Northwest
701 N.E. College Drive
St. Joseph 64507
816/271-3100
Fax: 816/271-3107

Northeast
2500 S. Halliburton
Kirksville 63501
660/785-2420
Fax: 660/785-2553

Kansas City
3424 N.W. Duncan Road
Blue Springs 64015
816/655-6250
Fax: 816/655-6256

St. Louis
2360 Highway D
St. Charles 63304
636/441-4554
Fax: 636/926-9125

Ozark
P.O. Box 138
551 Joe Jones Blvd.
West Plains 65775
417/256-7161
Fax: 417/256-0429

Central
1907 Hillcrest Drive
Columbia 65201
573/884-6861
Fax: 573/882-9807

Southwest
2630 N. Mayfair
Springfield 65803
417/895-6880
Fax: 417/895-6910

Southeast
2302 County Park Dr.
Cape Girardeau 63701
573/290-5730
Fax: 573/290-5736

Appendix 1: Forestry Measurements and Conversions

English and Forestry Measurements

Length

1 rod = 16.5 feet
1 chain = 66 feet = 4 rods
1 furlong = 10 chains = 660 feet
1 mile = 5,280 feet = 8 furlongs = 80 chains = 320 rods

Area

1 acre = 43,560 square feet = 4,840 square yards = 10 square chains
1 square chain = 1/10 acre
1 square mile = 640 acres = 1 section

Volume

1 board foot (bf) = 1 inch x 12 inches x 12 inches
1 cord = 128 cubic feet of air and wood = approximately 85 cubic feet of solid wood = approximately 500 bf
1 cord = approximately 2.5 tons of wood chips

Metric Conversions

Length

1 inch = 2.54 centimeters
1 yard = 0.914 meter
1 rod = 5.029 meters
1 mile = 1.609 kilometers
1 centimeter = 0.39 inch
1 meter = 39.37 inches = 3.28 feet = 1.09 yards
1 kilometer = 0.621 mile

Area

1 acre = 4,047 square meters = 0.405 hectare (ha)
1 square mile = 2.59 square kilometers = 259 ha
1 hectare = 2.47 acres
1 square kilometer = 0.386 square mile

Volume

1 cubic foot = 0.028 cubic meter
1,000 board feet (MBF) of logs measured in International 1/4-inch Rule = 3.48 cubic meters
1 cord (85 cubic feet of wood) = 2.42 cubic meters
1 cubic meter = 35.31 cubic feet
1 cubic meter = 0.287 MBF International 1/4-inch Rule

Weight

1 ounce = 28.349 grams
1 pound = 0.454 kilogram
1 ton = 2,000 pounds = 0.907 metric ton
1 metric ton = 1.1 tons

Appendix 2: Tree Volume Tables

Tree volume, in rough standard cords by number of 8-foot bolts*

Diameter breast high in inches	*Volume when number of bolts is*							
	1	2	3	4	5	6	7	8
	Cords	Cords	Cords	Cords	Cords	Cords	Cords	Cords
4	**0.007**	**0.011**						
5	.011	.019	**0.022**					
6	.017	.028	.040	**0.047**				
7	.023	.038	.053	.068	**0.076**			
8	.031	.050	.068	.087	.106	**0.116**		
9	.040	.065	.088	.109	.130	.153	**0.170**	
10	.049	.082	.111	.133	.160	.188	**.211**	
11	.060	.100	.137	.165	.190	.221	**.250**	**0.270**
12	.070	.121	.165	.198	.225	.260	.300	**.330**
13	.082	.143	.197	.236	.268	.305	.350	.42
14	.095	.167	.228	.273	.311	.353	.40	.47
15	.107	.193	.262	.318	.364	.41	.46	.52
16	.122	.220	.300	.367	.42	.47	.53	.59
17	.138	.250	.340	.42	.48	.54	.59	.66
18	.155	.282	.382	.47	.55	.60	.65	.73
19	.173	.318	.43	.53	.61	.68	.73	.81
20	.194	.353	.48	.59	.68	.76	.81	.89
21	.217	.395	.54	.66	.76	.84	.90	.98
22	.240	.44	.60	.73	.84	.93	1.00	1.07
23	.262	.48	.66	.80	.92	1.03	1.10	1.17
24	.288	.52	.72	.88	1.00	1.12	1.21	1.28
25	.312	.58	.78	.96	1.10	1.23	1.33	1.38
26	.340	.62	.84	1.04	1.19	1.33	1.44	1.51
27	.363	.67	.91	1.13	1.29	1.45	1.56	1.63
28	.388	.72	.97	1.20	1.38	1.55	1.67	1.76
29	.41	.76	1.03	1.29	1.49	1.66	1.80	1.90
30	.43	.80	1.10	1.37	1.59	1.7	1.93	2.04

*The bold figures in the upper portion of the table are to a minimum top diameter (inside bark) of 3.0 or more, but less than 4.0 inches. Other top diameters are variable but not less than 4.0 inches.

Table for Firewood Volume Estimation

Conversion Factor:
5,500 lbs./cord

DBH	NRO	TALLY	SUM	BO	TALLY	SUM	SO	TALLY	SUM	WO	TALLY	SUM	HICK	TALLY	SUM	RM	TALLY	SUM	DBH
2	14			16			19			10			14			16			2
3	40			45			50			32			40			44			3
4	87			92			102			69			85			92			4
5	158			161			175			128			152			160			5
6	257			254			272			211			244			252			6
7	388			372			397			322			367			370			7
8	555			518			548			464			520			518			8
9	760			694			730			641			709			695			9
10	1006			903			944			856			935			905			10
11	1298			1144			1190			1113			1200			1150			11
12	1638			1421			1470			1413			1508			1430			12
13	2028			1735			1786			1761			1861			1747			13
14	2472			2086			2138			2158			2260			2103			14
15	2972			2477			2528			2609			2709			2500			15
16	3530			2908			2957			3116			3208			2939			16
Total																			Total

To find number of cords:
1. Tally trees by DBH
2. Multiply tally by weight factor for each DBH
3. Divide by 5,500 lbs.

NRO = northern red oak
BO = black oak
SO = scarlet oak
WO = white oak
HICK = hickory
RM = red maple

Gross volume of tree
Doyle Rule (in board feet)

Diameter breast high in inches	*Volume when the number of 16-foot logs is*							
	1/2	1	1 1/2	2	2 1/2	3	3 1/2	4
12	20	30	40	50	60			
14	30	50	70	80	90	100		
16	40	70	100	120	140	160	180	190
18	60	100	130	160	200	220	240	260
20	80	130	180	220	260	300	320	360
22	100	170	230	280	340	380	420	460
24	130	220	290	360	430	490	540	600
26	160	260	360	440	520	590	660	740
28	190	320	430	520	620	710	800	880
30	230	380	510	630	740	840	940	1040
32	270	440	590	730	860	990	1120	1220
34	300	510	680	850	1000	1140	1300	1440
36	350	580	780	970	1140	1310	1480	1640
38	390	660	880	1100	1290	1480	1680	1860
40	430	740	990	1230	1450	1660	1880	2080
42	470	830	1100	1370	1620	1860	2100	2320

Gross volume of tree
International 1/4-inch Rule (in board feet)

Diameter breast high in inches	*Volume when the number of 16-foot logs is*							
	1/2	1	1 1/2	2	2 1/2	3	3 1/2	4
8	15	24	35	46				
10	21	39	54	68	76	81		
12	30	57	80	100	114	124	130	
14	42	79	110	140	163	184	194	205
16	59	105	147	180	213	247	274	295
18	74	135	188	235	278	320	360	400
20	92	170	236	295	350	400	450	500
22	112	209	290	362	430	495	555	610
24	133	252	346	430	510	595	670	740
26	158	300	410	510	605	700	790	880
28	187	348	480	595	700	810	920	1020
30	220	410	550	685	810	930	1060	1180
32	254	470	635	790	930	1070	1210	1350
34	291	530	725	900	1060	1210	1380	1530
36	333	600	820	1010	1190	1370	1550	1725
38	374	670	910	1120	1330	1530	1730	1930
40	415	745	1010	1250	1480	1700	1930	2160

Appendix 3:
Log Volume Tables

Log volume International 1/4-inch Rule (in board feet)						
Diameter *(small end)*	*Length of log in feet*					
	6	8	10	12	14	16
6	5	10	10	15	15	20
7	10	10	15	20	25	30
8	10	15	20	25	35	40
9	15	20	30	35	45	50
10	20	30	35	45	55	65
11	25	35	45	55	70	80
12	30	45	55	70	85	95
13	40	55	70	85	100	115
14	45	65	80	100	115	135
15	55	75	95	115	135	160
16	60	85	110	130	155	180
17	70	95	125	150	180	205
18	80	110	140	170	200	230
19	90	125	155	190	225	260
20	100	135	175	210	250	290
21	115	155	195	235	280	320
22	125	170	215	260	305	355
23	140	185	235	285	335	390
24	150	205	255	310	370	425
25	165	220	280	340	400	460
26	180	240	305	370	435	500
27	195	260	330	400	470	540
28	210	280	355	430	510	585
29	225	305	385	465	545	630
30	245	325	410	495	585	675

Log volume
Doyle Log Rule (in board feet)

Diameter (small end)	*Length of log in feet*					
	6	8	10	12	14	16
6	2	2	3	3	4	4
7	3	5	6	7	8	9
8	6	8	10	12	14	16
9	9	13	16	19	22	25
10	14	18	23	27	32	36
11	18	25	31	37	43	49
12	24	32	40	48	56	64
13	30	41	51	61	71	81
14	38	50	63	75	88	100
15	45	61	76	91	106	121
16	54	72	90	108	126	144
17	63	85	106	127	148	169
18	74	98	123	147	172	196
19	84	113	141	169	197	225
20	96	128	160	192	224	256
21	108	145	181	217	253	289
22	122	162	203	243	284	324
23	135	181	226	271	316	361
24	150	200	250	300	350	400
25	165	221	276	331	386	441
26	182	242	303	363	424	484
27	198	265	331	397	463	529
28	216	288	360	432	504	576
29	234	313	391	469	547	625
30	254	338	423	507	592	676

Appendix 4: Sample Solicitation of Bid for Timber

December 15, 20____

You are invited to bid on timber located as follows: in the NW 1/4, Section 23, Township 25 North, Range 14 West, Timber County, Missouri. The timber is located five miles south of Oak Grove on Route AB.

For additional information or for directions on how to see the timber, contact: Forrest Farmer, Oak Grove, Missouri; telephone 573/555-1234.

DESCRIPTION:

Approximately 160 acres of mixed oak timber. The trees to be cut are marked with a fresh orange paint spot at breast height and on the stump. About 1,600 trees are marked. Bids are to be made on a lump sum basis.

BID INSTRUCTIONS:

After the bid is completed, return it to: Forrest Farmer, Route 1, Oak Grove, MO 61234, on or before 1:00 p.m., January 15, 20____

Mark “TIMBER BID” on the envelope.

The owner reserves the right to reject any or all bids.

BIDDER: _____ TELEPHONE: _____

ADDRESS: _____ SIGNATURE: _____

_____ AMOUNT OF BID: _____

Appendix 5:
Sample Timber Sale Contract

Timber Sale Contract

Joe Logger of Big Cedar, Missouri, hereinafter called the Buyer, agrees to purchase from Forrest Farmer of Oak Grove, Missouri, hereinafter called the Seller, the designated timber specified below:

WITNESSETH:

ARTICLE I. The Seller hereby agrees to sell to the Buyer, subject to the terms listed below, all of the timber specified below, on a certain tract owned by the Seller, located in NW 1/4, Section 23, Township 25 North, Range 14 West, County of Timber, State of Missouri, located on 160 acres, more or less.

ARTICLE II. The Buyer agrees:

1. To cut only those trees marked with a fresh orange paint spot. Trees marked with an "X" may be cut if desired.

2. Trees other than those specified above may be cut only for access on areas used for roads and landings.

3. To pay the Seller a lump price of $12,000.00 when the contract is signed to pay for the trees designated for cutting.

4. To pay three times the stumpage value per tree, a penalty rate, for each tree that is cut which is not designated for cutting.

5. To keep fields, fences, roads, and streams free from tree tops and other logging debris at all times.

6. To hold and save the Seller, his officers, agents or employees, harmless from any or all liability on account of any claim whatsoever, for wages, supplies, equipment, damage and injury to persons or property arising in connection with any activity conducted or undertaken by the Buyer, his agents or employees under the terms of this contract.

7. That this contract cannot be transferred to another party without the written permission of the Seller.

ARTICLE III. The following conditions known as Best Management Practices and referenced in the Missouri Conservation Department publication "Missouri Watershed Protection Practices" apply to the sale of said forest products and will be adhered to by the Buyer:

1. All roads constructed and used during the cutting and transportation of forest products shall follow the contour with slope grades of 8 percent or less maintained, except where terrain or the use of existing roads requires short, steep grades necessitating the construction of water diversion measures (water bars, broad-based dips, turnouts, culverts) installed at the proper intervals.

2. New roads will be constructed to allow for proper drainage.

3. Except at stream crossings, roads will not be constructed within ____ feet [the corresponding

Streamside Management Zone (SMZ)] of any stream, pond or lake on the property.

4. All exposed soil at stream crossings will be stabilized with gravel, grass and mulch, or silt fences to prevent erosion and sedimentation.

5. Under no circumstances will temporary stream crossings made of logs and brush piled in the stream and covered with soil be permitted.

6. Wheeled and tracked equipment are not allowed within ____ feet (the SMZ) of any stream, pond or lake on the property. Trees marked for cutting within the SMZ should be chainsaw felled and cable winched out.

7. Log decks, portable sawmills or chippers are not allowed within ____ feet (the SMZ) of any stream, pond or lake on the property.

8. All roads on and adjacent to the sale area used by the Buyer shall be reshaped, seeded and mulched, and have water diversion structures installed upon completion of the sale as prescribed in "Missouri Watershed Protection Practices."

9. All human garbage, tires, cables, used lubricants, fuels, fluids and containers used by the Buyer shall be removed from the sale area and disposed of properly by the Buyer.

10. The Seller or Forester in charge may temporary terminate hauling and/or skidding during periods of wet soil conditions should these operations be causing or likely to cause damage beyond normal wear and tear to the roads and trails. The number of working days that the Buyer's operations are terminated for this reason shall be added to the term of this contract upon request of the Buyer.

ARTICLE IV. The Buyer further agrees to cut and remove said timber in strict accordance with the following conditions:

1. To waive all claims to the above described trees unless they are cut and removed on or before December 31, 20___.

2. To cut all spring poles and pull all lodged trees to the ground.

3. To do all in his power to prevent and suppress forest fires on or threatening the sale area.

4. To protect from unnecessary injury young growth and other trees not designated for cutting.

5. To repair damage caused by logging to fences, bridges, roads, trails or other improvements damaged beyond ordinary wear and tear.

6. To allow the owner to cut and remove any portion of a tree left on the ground by the Buyer after he has removed his products.

ARTICLE V. The Seller agrees to the following conditions:

1. To guarantee title to the forest products covered by this agreement and to defend it against all claims at his expense.

2. To grant or secure necessary entry and right-of-way to the Buyer and his employees on and across the area covered by this agreement, and also other privileges usually extended to Buyers.

ARTICLE VI. It is mutually understood and agreed by and between the parties hereto as follows:

1. All timber included in this agreement shall remain the property of the Seller, and shall not be removed until paid for in full.

2. In case of a dispute over the terms of this contract, we agree to accept the decision of an arbitration board of three selected persons as final. Each of the contracting parties will select one person and the third will be the State Forester or his chosen representative.

Signed in duplicate this _____ day of _____, 20____.

_____ _____
(Witness) (Buyer)

_____ _____
(Witness) (Seller)

_____ _____
(Witness) (Seller)

ACKNOWLEDGMENT

STATE OF _____
COUNTY OF_____

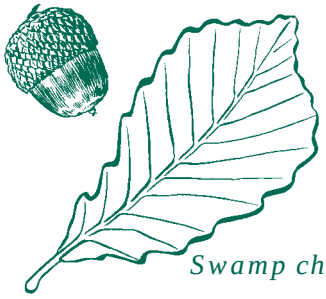
On this _____ day of _____, 20 _____ before me personally appeared _____ to be known to be the person(s) described in and who executed the foregoing instrument and acknowledged that _____ executed same as _____ free act and deed.

In Testimony Whereof, I have hereunto set my hand and affixed my official seal, at my office in _____, the day and year first above written.

My Commission as Notary Public Expires _____.

_____
NOTARY PUBLIC

Appendix 6: Pacing



Pacing is a fundamental skill in woods work. The ability to pace off a distance with reasonable accuracy is useful and is easy to master. A tape measure should be used when exact distances are critical, such as the radius of a sample plot. Pacing can be used to find property corners, measure the distance between sample plots, estimate the size of forest stands and pace off the base distance when measuring tree height.

Follow these steps to determine the length of your pace:

1. With a measuring tape, mark off 100 feet in the woods.
2. Starting with one foot, count a pace each time the opposite foot is put down (2 steps = 1 pace). Using a normal stride, pace the measured 100 feet several times, noting each time the number of paces it takes to travel the distance. (Note: An exaggerated pace is impossible to maintain all day through forest cover.)
3. Divide the sum of the total number of paces by the number of times you paced the 100-foot distance. This figure is the average number of paces it took to walk 100 feet.
4. The length of your pace will be equal to 100 feet divided by the average number of paces it took to travel the 100 feet (calculated in step 3).

Example 1

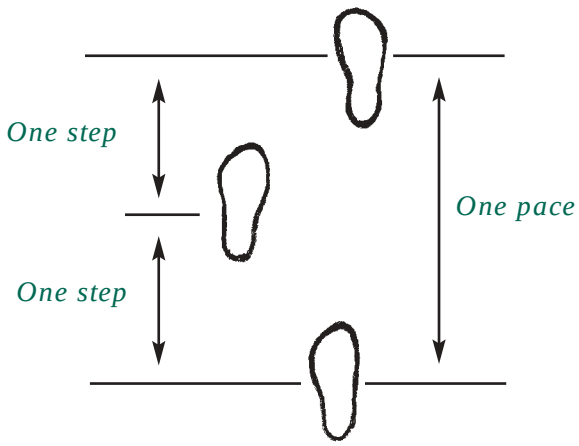
A person took a total of 73 paces to travel a 100-foot distance four times. What is his pace length?

1. Divide 73 by 4 (=18.25). This is the average number of paces to walk 100 feet.
2. Divide 100 by 18.25. The pace length is 5.5 feet.

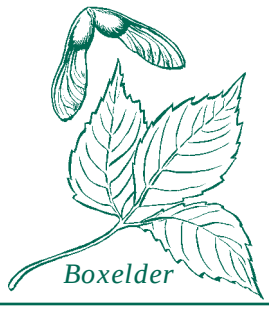
Example 2

A person with an average pace of 5.5 feet found that a rectangular forest stand measured 70 paces by 105 paces. What is the approximate area of the stand in acres?

1. Convert paces to feet: 70 paces x 5.5 = 385 feet, and 105 paces x 5.5 = 577.5 feet.
2. Calculate the area of the stand in square feet: area of the rectangle = length x width, so area = 385 feet x 577.5 feet = 222,337.5 square feet
3. To find acres, divide the area of the stand by the number of square feet in an acre (43,560): 222,337.5/43,560 = 5.1 acres.



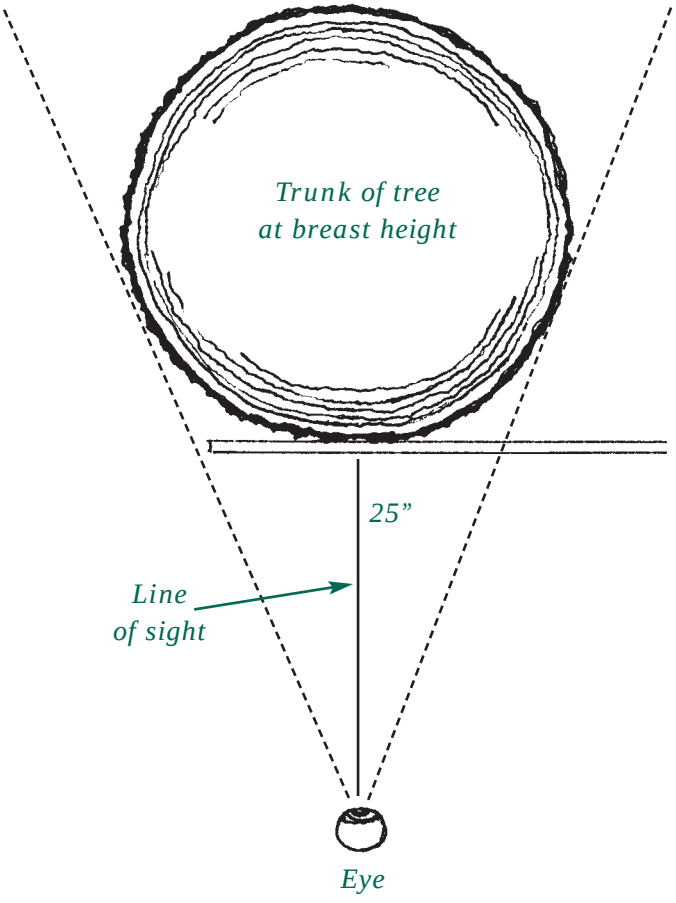
Appendix 7: Using a Scale Stick

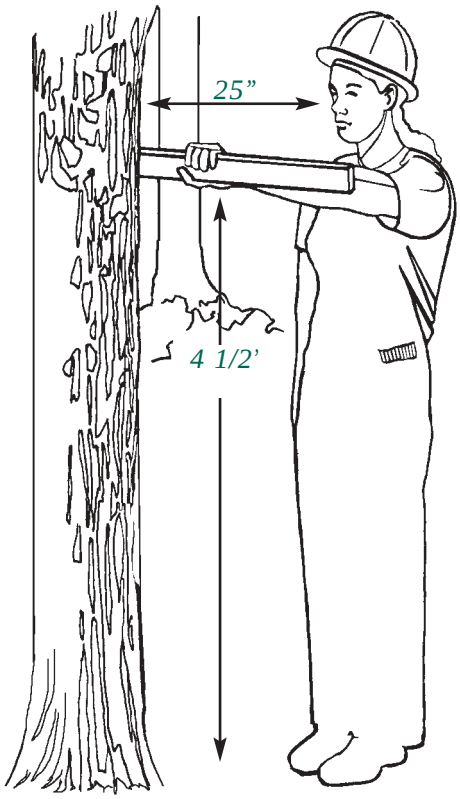


A scale stick or cruising stick resembles a yardstick but has different scales for measuring trees and logs. Most scale sticks have three measurement scales: a Biltmore scale for measuring tree diameter in inches (DBH), hyposmeter for determining the number of logs in a standing tree and a log scale for measuring the board foot volume of a log. Sticks may be purchased with different log scales. Free scale sticks are available from any Department of Conservation forester.

How to measure the diameter of a tree

1. Hold the stick horizontally against the tree, 4 1/2 feet from the ground and 25 inches from your eyes. Be sure the diameter measurement side is toward you and not the log scale side.
2. Look directly at the center of the tree. Without moving your head, shift your eyes to the left and line up the zero end of the stick with the outside edge of the tree.
3. Without turning your head, look at the right side of the tree and read the number closest to where your line of sight crossed the stick. This is the DBH in inches.
4. If the trunk does not have a uniform diameter, measure the diameter at both the widest and narrowest points and average the two.

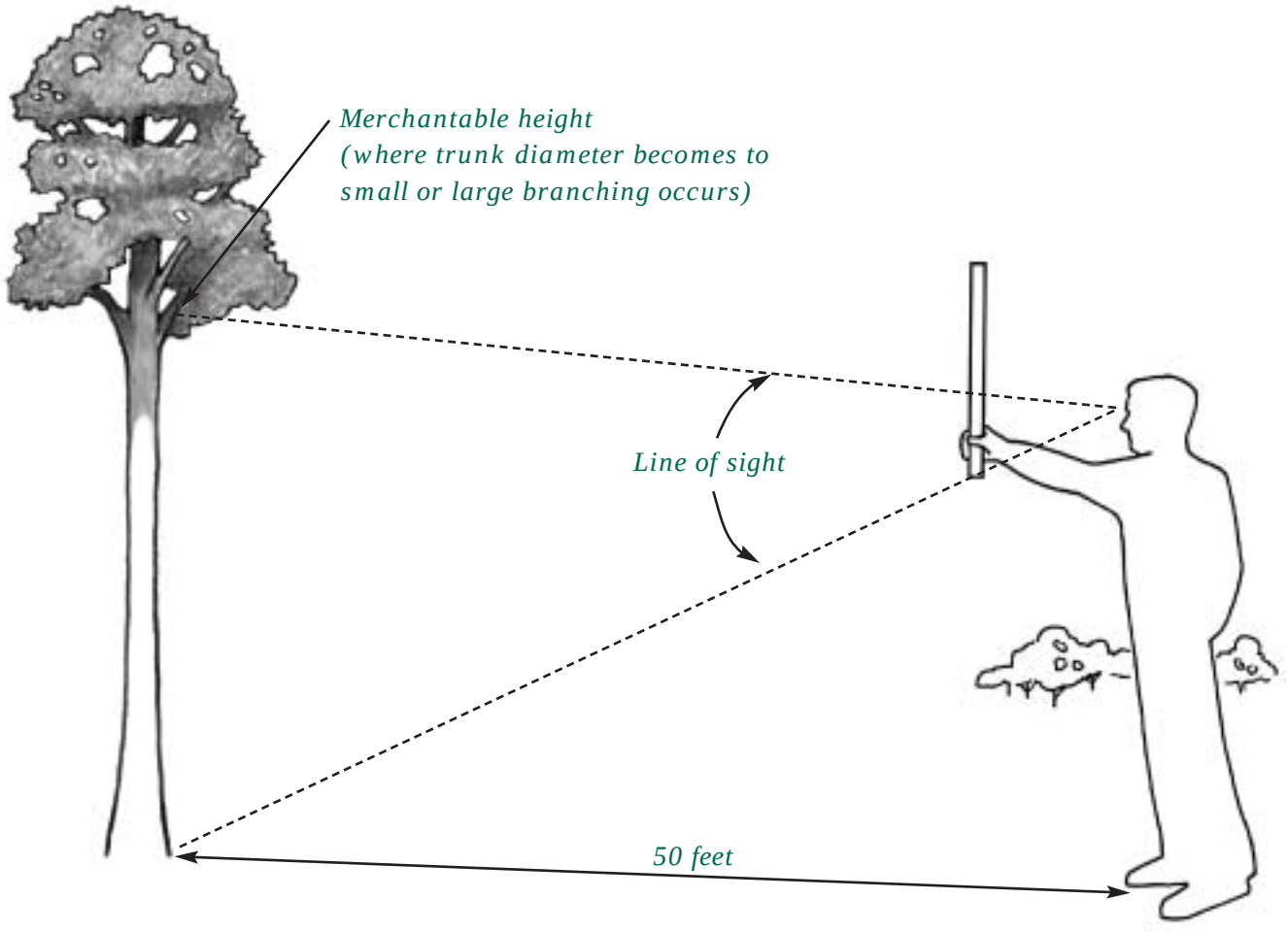




How to measure the number of logs in a tree

1. Pace off 50 feet from the tree, as level as possible with its base. (Note: Some scale sticks have a 66-foot base distance. The base distance will be printed on the stick.)
2. Find the point where the trunk diameter becomes too small or large branching occurs. This is the merchantable height. For sawlogs, the merchantable height is usually to a top diameter of 8 inches. For pulpwood, figure about a 4-inch diameter.
3. Hold the stick 25 inches from your eye in a vertical position. Be sure the side with the "number of 16-foot logs" is toward you.
4. Line up the zero end with the stump height, usually about 1 foot above the ground.
5. Without moving your head, shift your eyes to the merchantable height. Be sure the stick is vertical and not tilted. The point where your line of sight intersects the stick is the number of logs. Read the measurement to the half-log. If the reading falls between two numbers, record to the next lower half-log.

Using the DBH and number of logs, you can estimate the board foot volume in a tree. This process is outlined in Appendix 9.



Appendix 8: Conducting a Fixed Area Plot Cruise

Except for high-value trees such as walnut and veneer, it is not practical to measure every tree in the stand. Instead, accurate measurements are made on a number of sample plots and this information is expanded for the entire stand. To give an accurate estimate, the plots must be located throughout the forest stand. The sample plots can be located by any number of complicated sampling designs, however, in most forest inventories the plots are located at regular intervals on transect lines a set distance apart. Sample plots located at uniform intervals is commonly called a systematic sample.

Plots can be any shape—circular, square, rectangular or triangular—but circular plots are most commonly used. The size of the plot should vary with the type of forest being inventoried. For most forest inventories in Missouri, plots of 1/10- or 1/20-acre are recommended. In stands of large, scattered trees, 1/5-acre plots may give more accurate results. Small plots of 1/250- to 1/1000-acre are used for regeneration counts. The accompanying table gives the areas and dimensions of several sizes of plots.

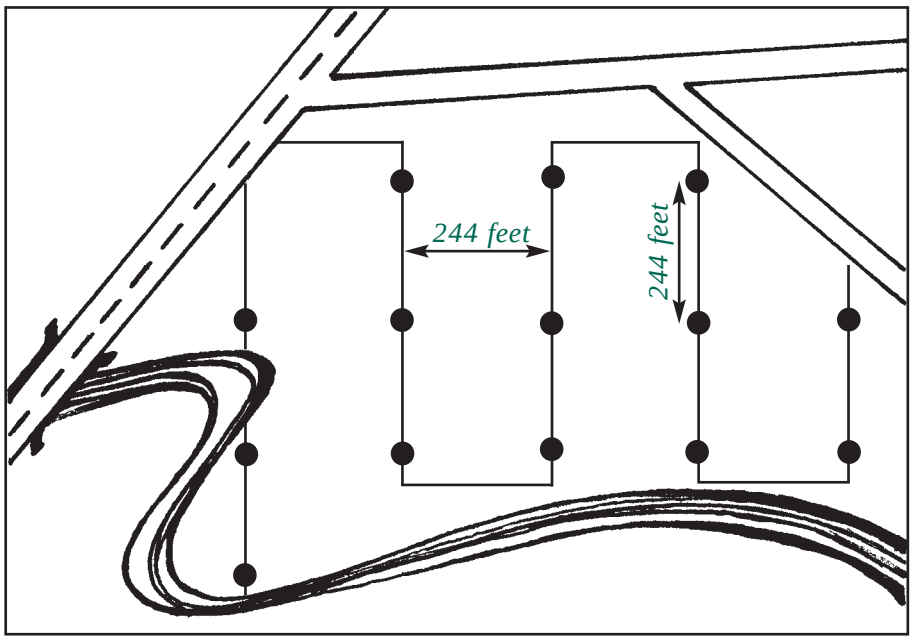
To determine the number of sample plots needed, use the following guidelines. In stands of 30 acres or less, sample one plot per acre. In larger stands, sample 24 plots plus one additional plot for each 5 acres. For example, in a 45-acre stand you would sample 33 plots (24 + [45/5] = 33). This sampling intensity usually will give estimates within 20 percent of the actual stand volume.

Plots should be distributed throughout the stand to obtain a representative sample. This is especially important in stands where there is variation in tree size, species composition and stand density. Use a compass to run transect lines perpendicular to landforms and drainages.

The following formula can be used to determine the distance between transect lines and sample plots:

$$D = 208.71 \sqrt{\frac{A}{n}}$$

where: D = distance in feet between transect lines and sample plots on a line, A = number of acres in the stand, and n = number of sample plots.



In the above example, there are 45 acres in the stand and 33 sample plots, so the distance between lines and sample plots should be 244 feet.

The following equipment is needed for the field work:

- Compass to determine direction between plots
- Steel tape to measure plot radius
- Scale stick for measuring tree diameters and log lengths
- Tally sheets to record tree measurements
- Penny to measure basal area.

Using a sapling or walking staff as the center of the plot, measure the radius of the plot with a tape, as determined from the accompanying table. Measure several radii from the plot center and mark the plot boundaries with flagging on trees or scuff marks on the ground. On a tally sheet like the one in Appendix 9, record the species, diameter and number of logs for each tree in the plot. It is easier to remember where you began if you always start facing north and work in a clockwise direction back to your starting point. Also remember to measure basal area (see Appendix 11) at each plot so you can determine stand density.

Area and Dimensions of Sample Plots

Plot Size in acres	*Decimal*	*Square Plot Side in feet*	*Circular Plot Radius in feet*
1	1	208.7	117.8
1/2	0.5	147.6	83.3
1/4	0.25	104.4	58.9
1/5	0.20	93.3	52.7
1/10	0.1	66.0	37.2
1/20	0.05	46.7	26.3
1/100	0.01	20.9	11.8
1/250	0.004	13.2	7.4
1/500	0.002	9.3	5.3
1/750	0.0013	7.6	4.3
1/1000	0.001	6.6	3.7

Appendix 9: Cruise Tally Sheet

The timber cruise collects specific information needed to estimate the volume of standing trees. The information you collect also can tell you the number of trees per acre, basal area and stand density. Appendices 7, 8 and 11 explain how to make tree measurements and set up your cruise.

The accompanying tally sheet can be copied and used to record tree measurements. Because the cruise is just an estimate, DBH is recorded to the nearest even inch. Merchantable height is tallying to an 8-foot stick or half 16-foot log. When merchantable height falls between values, always record to the next lower half-log length. For example, if the merchantable height of a tree falls between 1 1/2 and 2 logs, record 1 1/2 logs. Record each tree by DBH and merchantable height, using a legend to distinguish between species.

After all the plots in a stand have been measured, use a tree volume table in Appendix 2 to calculate the volume. The numbers in each cell of the sample tally sheets show the volume that one tree of that dimension will contain (International 1/4-inch Rule). Use a different tree scale if preferred.

Sum plot volumes by species and DBH on the summary sheet. You now have a species volume for the plots measured. This needs to be expanded to a "per acre" basis. Use the following formula to convert species volume to total volume per acre:

$$\text{Volume/acre} = \frac{\textit{Species total}}{\textit{No. plots x plot size}}$$

On the example below, white oak volume is 539 board feet. White oak volume per acre = species volume/(no. plots x plot size) = 539/(4 x 0.1) = 1,347 board feet per acre.

This basic formula can be used to calculate the number of trees per acre. Number of trees and basal area are used to determine stand density (See Appendix 12). Tally all live trees in the plot. Number of trees per acre = no. tallied trees/(no. plots x plot size).

Example 1

Using the sample tally sheet, calculate the per acre volume of each tree species and the total volume.

White oak = 1,347 bf/acre (from above)

Black oak = ____ bf/acre

Post oak = _____ bf/acre

Hickory = _____ bf/acre

Pine = _____ bf/acre

Other = _____ bf/acre

Total = _____ bf/acre

Example 2

You measured all trees on five 1/5 acre plots. The tally sheet shows 175 trees measured. How many trees per acre are in this stand?

Answers:

Example 1: White oak = 1,347 bf/acre, Black oak = 1,635 bf/acre, Post oak = 442 bf/acre, Hickory = 412 bf/acre, Pine = 1,325 bf/acre, Other = 105 bf/acre, Total = 5,266 bf/acre

Example 2: 175 trees/acre

Sample Tally Sheet

DBH	Number of 16-foot logs							# Plots ⁘ (1/10 acre)
	1/2	1	1 1/2	2	2 1/2	3	3 1/2	
12	H ▲ 30	❍ 57	80	100				**Legend**
14	▲ ✚ 42	● 79	110	140	163	184		❍ White Oak
16	59	● ▲ 105	● ❍ ❍ 147	180	213	247	274	● Black Oak
18	74	H ● 135	● ❍ 188	✕ 235	278	320	360	▲ Post Oak
20	92	170	236	✕ 295	350	400	450	H Hickory
								✕ Pine
								✚ Other

Sample Summary Sheet

DBH	White Oak	Black Oak	Post Oak	Hickory	Pine	Other
12	57		30	30		
14		79	42			42
16	294	252	105			
18	188	323		135	235	
20					295	
Species total	539	654	177	165	530	42

$$\text{Volume/acre} = \frac{\textit{Species total}}{\textit{No. plots x plot size}}$$

Tally Sheet
Fixed Area Plot Cruise

Owner:
Location:
Date:

Cordwood Tally

DBH	1 stick	2 sticks	3 sticks	4 sticks	5 sticks	# 8-foot sticks
4	.007	.011				# Points
6	.017	.028	.040	.047		
8	.031	.050	.068	.087	.106	Legend
10	.049	.082	.111	.133	.160	
Total						

Sawtimber Tally

DBH	Number of 16-foot logs						
	1/2	1	1 1/2	2	2 1/2	3	3 1/2
12	30	57	80	100	114	124	130
14	42	79	110	140	163	184	194
16	59	105	147	180	213	247	274
18	74	135	188	235	278	320	360
20	92	170	236	295	350	400	450
22	112	209	290	362	430	495	555
24	133	252	346	430	510	595	670
26	158	300	410	510	605	700	790
28	187	348	480	595	700	810	920
30	220	410	550	685	810	930	1060
32	254	470	635	790	930	1070	1210
34	291	530	725	900	1060	1210	1380

Summary Sheet

Owner:
Location:
Date:

Cordwood Volume

DBH	Species						
4							
6							
8							
10							
Species total							

Total cordwood volume:

Sawtimber Volume

DBH	Species						
12							
14							
16							
18							
20							
22							
24							
26							
28							
30							
32							
34							
Species total							

Total sawtimber volume:

Appendix 10: Site Index

The growth rate and quality of Missouri's forests depend greatly on the site. An early step should be determining the site quality of your land for a variety of tree species. This information will allow you to compare growth rates and value so you can favor the species best suited for the site. Knowing site quality will help you decide what levels of management and investment will be profitable.

Site quality is expressed as site index. Site index is the average height of dominant and co-dominant trees at a given age called the index age. In Missouri, 50 years is commonly used as the index age. Sometimes 25 or 30 years are used in fast-growing bottomland hardwoods; and in the western United States, 100 years may be used. Site index is used to predict site quality because it correlates well with site productivity, is easily measured and is not affected by stand stocking.

How to measure the site index

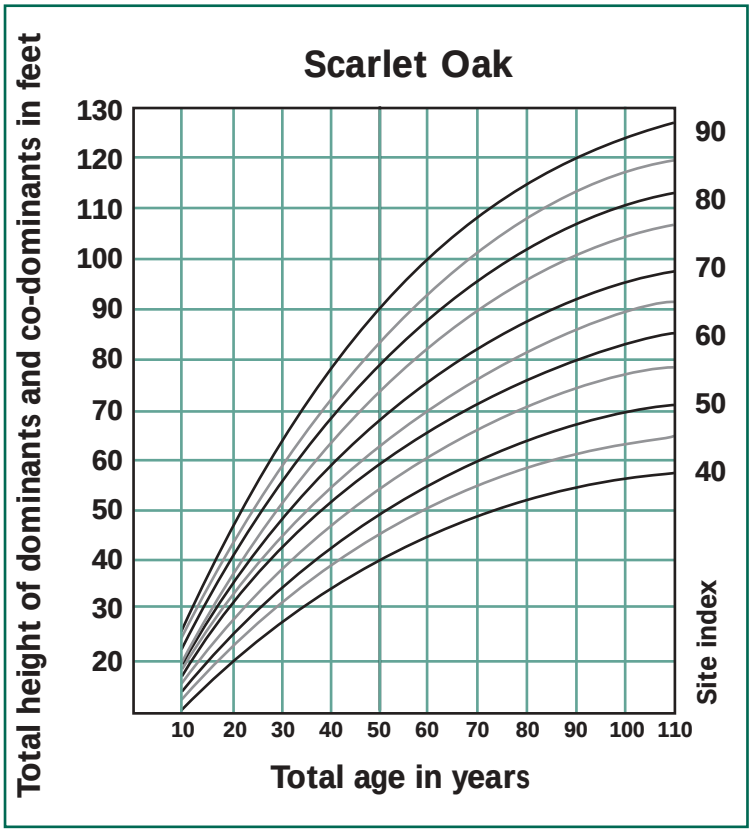
1. Select 5 to 10 sample trees distributed over the forest stand. Sample trees should be the same species if possible. They should be healthy dominant or co-dominant trees with straight, single-stemmed trunks. Reject trees that have been damaged by storms, pests, fire or grazing.
2. Measure the total tree height.
3. Determine tree age from increment cores or stump ring counts. For increment cores taken at breast height, add 2 to 5 years to obtain total age. Count the rings carefully, using a hand lens if necessary. Each one-year error can cause a 1- to 2-foot error in site index.
4. Site index curves have been developed for most commercial species. Select appropriate curves for the species you sampled. Draw a horizontal line that represents the average tree height. Draw a vertical line that represents the average tree age. The point of intersection is the site index of that stand.

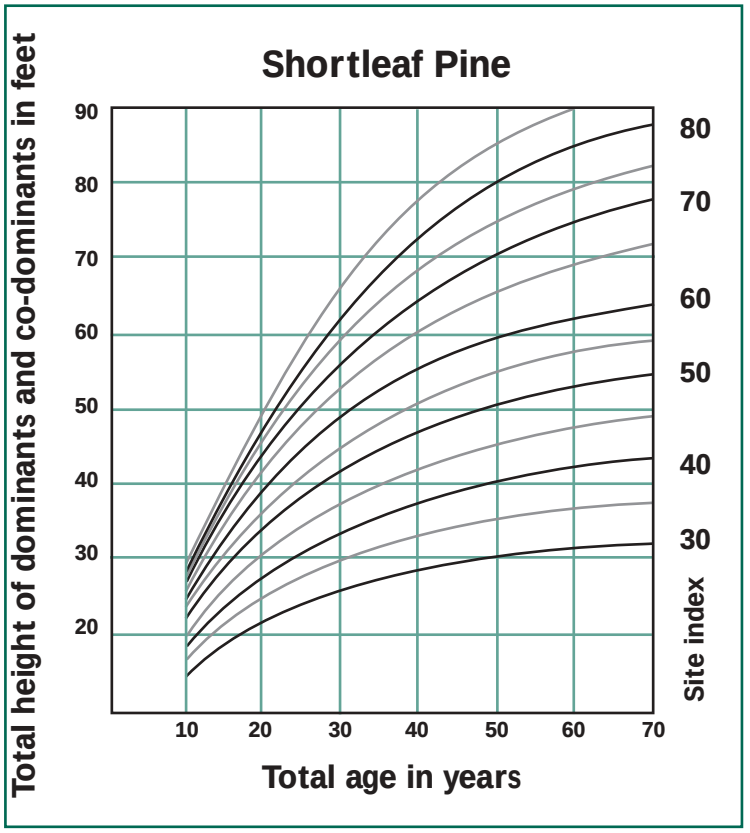
Broad site quality categories

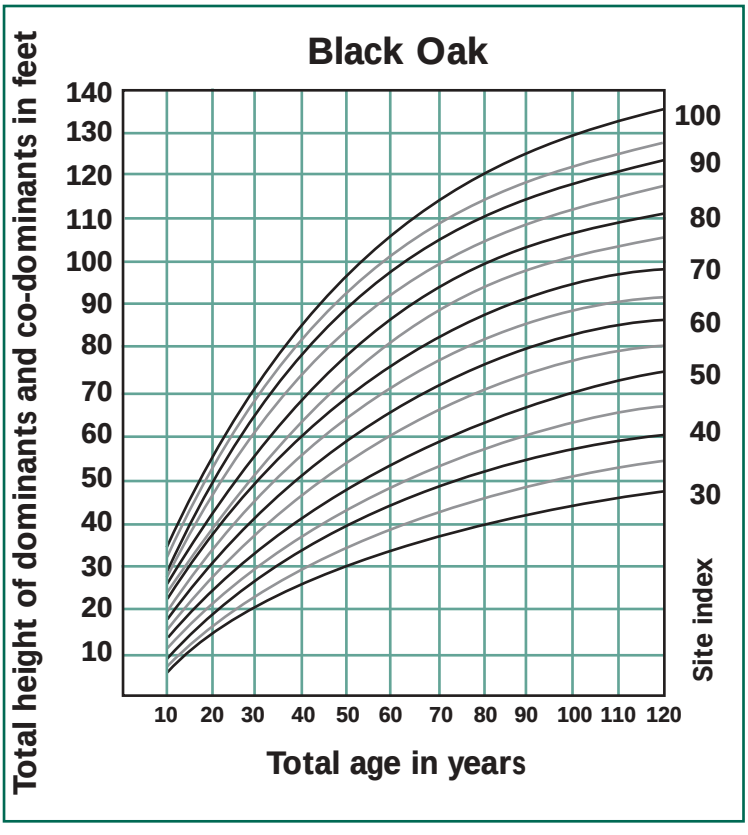
Good sites = site index 75+

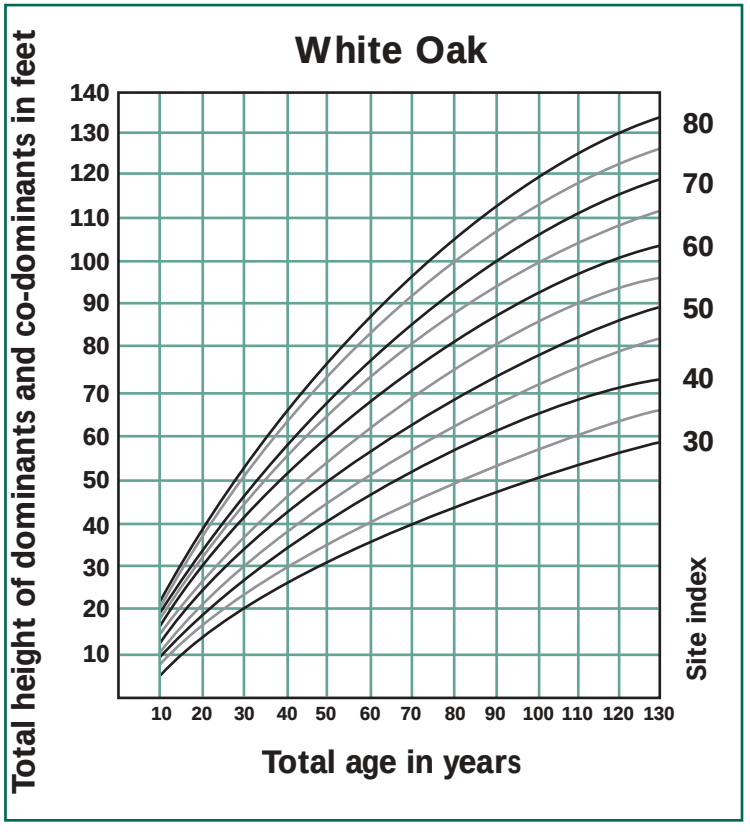
Average sites = site index 55-74

Poor sites = site index 40-54


Scarlet Oak
Total height of dominants and co-dominants in feet
130
120
110
100
90
80
70
60
50
40
30
20
10 20 30 40 50 60 70 80 90 100 110
Total age in years
90
80
70
60
50
40
Site index


Shortleaf Pine
Total height of dominants and co-dominants in feet
90
80
70
60
50
40
30
20
10 20 30 40 50 60 70
Total age in years
80
70
60
50
40
30
Site index


Black Oak
Total height of dominants and co-dominants in feet
140
130
120
110
100
90
80
70
60
50
40
30
20
10
10 20 30 40 50 60 70 80 90 100 110 120
Total age in years
100
90
80
70
60
50
40
30
Site index


White Oak
Total height of dominants and co-dominants in feet
140
130
120
110
100
90
80
70
60
50
40
30
20
10
10 20 30 40 50 60 70 80 90 100 110 120 130
Total age in years
80
70
60
50
40
30
Site index

Species recommendations for timber production by site index

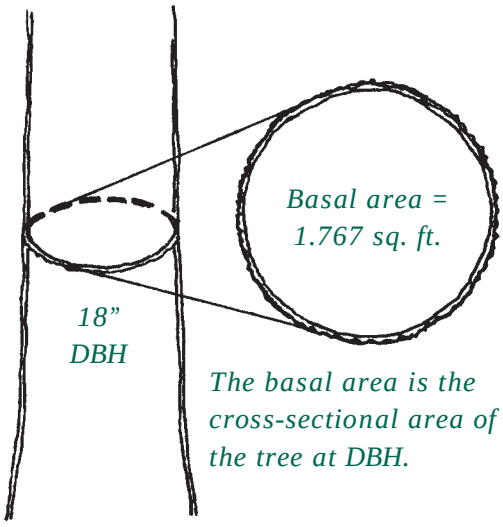
Site Index	Preferred Species	Acceptable Species	Undesirable Species[3]
75+	Black oak Cottonwood Black walnut Sweetgum Northern red oak Sycamore White oak Ash Black cherry Silver maple	Shortleaf pine Scarlet oak Southern red oak Black oak Ash Basswood Hickory Post oak[2] Hackberry	Sugar & black maple Elms Blackjack oak Blackgum Chinkapin oak Persimmon Mulberry Dogwood Sassafras
55-74	Black oak Scarlet oak Northern red oak White oak Shortleaf pine Black walnut[1] Black cherry[1]	Southern red oak Sycamore[1] Ash[1] Hickory Post oak[2] Silver maple Basswood	Blackjack oak Sugar & black maple Blackgum Elms Chinkapin oak Persimmon Mulberry Dogwood Sassafras
40-54	Shortleaf pine Black oak Eastern redcedar	White oak[1] Northern red oak Post oak[2] Hickory Scarlet oak Chinkapin oak	Blackjack oak Sugar & black maple Blackgum Elms Ash Black cherry Persimmon Dogwood Sassafras Sycamore

[1] Better sites

[2] Post oak can be acceptable if it is the same size as the main stand and has satisfactory form and soundness.

[3] Undesirable for timber production, but may be acceptable to meet mast, snag and den tree objectives.

Appendix 11: Basal Area



Basal area, an index of stand density, is a measurement often made during forest inventory. Basal area is defined and calculated in two ways.

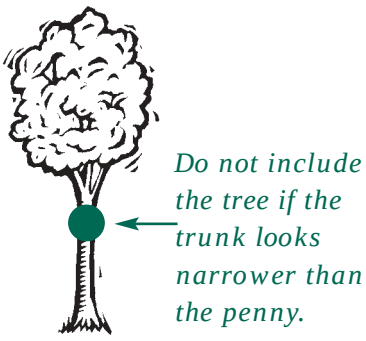
1. The basal area, or BA, of an individual tree is the cross-sectional area of the trunk at DBH (4 1/2 feet above the ground). If a tree were cut at DBH, the basal area would be the flat top of the stump. The basal area of a tree can be calculated with the formula: BA = 0.00545 x DBH^2. The basal area of a tree with a 18-inch DBH is 1.767 square feet (0.00545 x 18^2).
2. The basal area of a stand is the sum of the basal areas of the individual trees and is expressed in square feet per acre. A well-stocked hardwood stand might have a basal area of 60-100 square feet per acre.

From the inventory data collected in a fixed area plot cruise (See Appendix 8), you can determine the basal area per acre by calculating the basal area of each tree and expanding this figure to a per acre basis. However, since basal area is such a common measure of stand density, tools have been developed to determine it quickly without actually measuring and calculating the basal area of every tree.

Prisms and angle gauges are two such tools. These tools work in different ways, but both indicate the number of trees in a sample plot that should be counted and recorded. Prisms and angle gauges in Missouri are calibrated to have a basal area factor of 10. That is, each tree counted represents 10 square feet of basal area.

A penny works as a 10 basal area factor angle gauge. To measure basal area using a penny, follow these steps.

1. Locate the plot center (see Appendix 8 for locating sample plots).
2. Standing at plot center, hold the bottom edge of the penny between two fingers and aim it at a spot on the tree at DBH.
3. Hold the penny 25 inches from one eye and close the other eye.
4. Count and record trees with trunks that look wider than the penny. Do not count a tree if its trunk looks narrower than the penny. Count every other tree with a trunk that is the same size as the penny.
5. Holding the penny over the plot center, repeat this test on all trees within your view by rotating to the right until you return to the starting point.
6. Multiply the number of countable trees by 10 (10 basal area factor) to obtain the square feet of basal area per acre. For example, if you counted 9 trees on the plot, the basal area per acre would be 90 square feet.
7. Measure the basal area on several plots in the stand and average to obtain the average basal area per acre.



Illustrations courtesy of Forest Releaf of Missouri

Appendix 12: Stand Density

A forest stand must have a sufficient number of trees to efficiently use the available growing space. Stand density is a way of measuring crowding between trees and may be expressed as basal area per acre, degree of crown closure or number of trees per acre. Very dense stands grow slow while low density stands do not fully use the productive potential of the site.

Measurements taken during an inventory can be used to determine the stocking level of a forest stand. Using a stocking chart, a stand can be characterized as being overstocked, fully stocked or understocked. Stocking charts relate basal area per acre, average stem diameter and number of trees per acre. The basic premise of the stocking chart is that as trees grow larger in diameter and crown size, there will be fewer trees per acre.

The basic data needed to determine stand stocking are basal area and number of trees per acre. Follow these steps using the stocking charts on the next page:

1. Draw a vertical line that represents the number of trees per acre.
2. Draw a horizontal line that represents the average basal area per acre.
3. The point of intersection shows the average tree diameter. From the point of intersection, project a line parallel to the next lower tree diameter diagonal to the B line.

Stands that are stocked above the A line are overstocked. In this situation, the stand will grow slow because of competition for sunlight, moisture and nutrients. Although many of the surplus trees in overstocked stands will eventually die, it is a slow process. Overstocked stands should be thinned to increase tree growth and improve forest health.

When stocking falls between the A and B lines, the stand is fully stocked. Trees make their best growth when stocking is at this level. When thinning, stocking levels are usually reduced to the B line.

Stocking between the B and C lines is understocked. Not enough trees are present to use the full growth potential of the site. When stocking is near the C line, it will take about 10 years for trees to grow to the B line.

Example

Your inventory shows a stand has 200 trees per acre and an average basal area of 88 square feet. Find the average diameter. Is this stand over-, under- or fully stocked? If you were to conduct a thinning to B-level, how many trees per acre would remain after the thinning? What would be their average spacing?

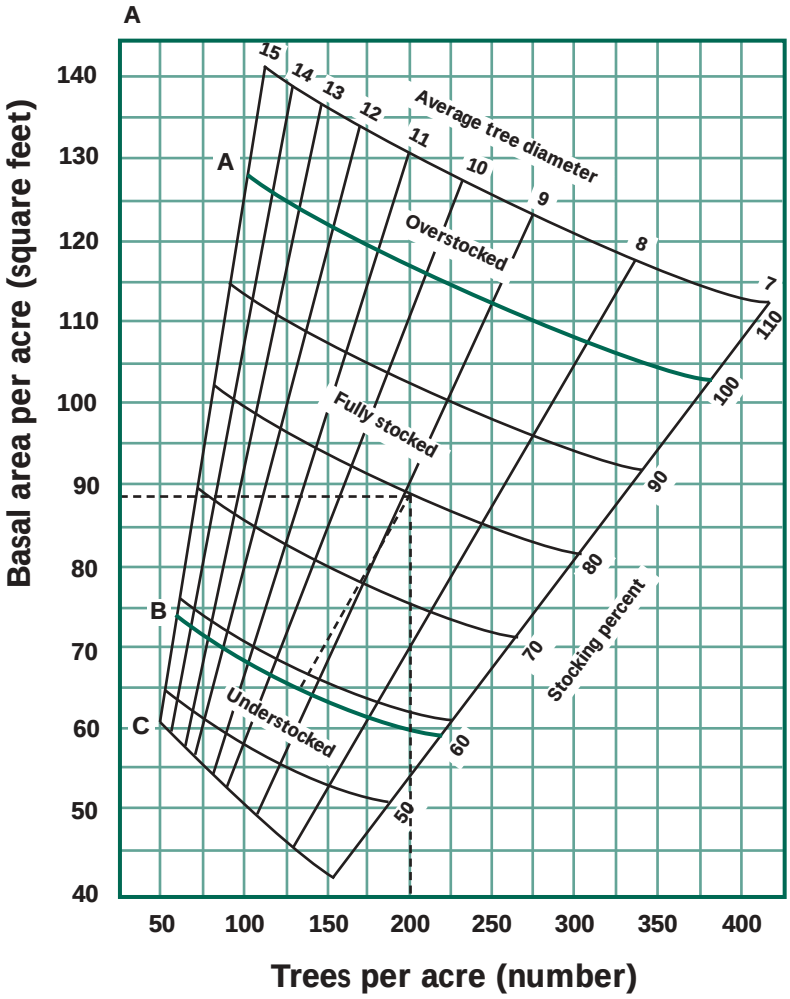
Answers

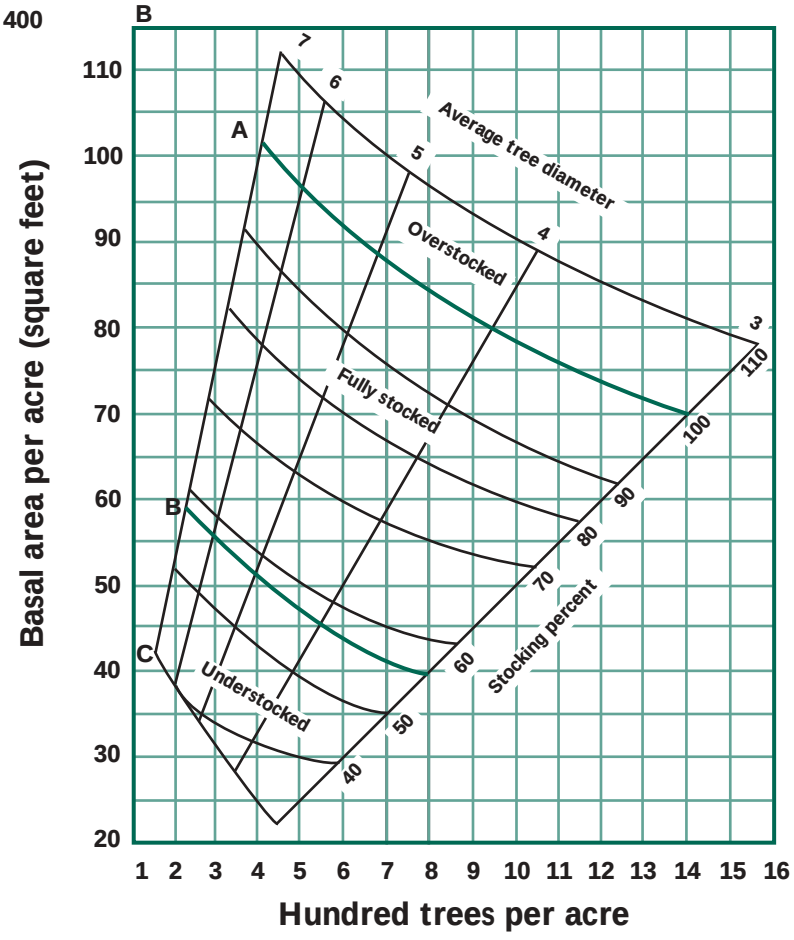
Average diameter = 8.9 inches

This stand is fully stocked.

130 trees per acre after thinning.

Average spacing after thinning = 18 feet $\sqrt{\frac{43{,}560 \text{ sq. ft./acre}}{130 \text{ trees/acre}}} = 18 \text{ feet}$


A
Basal area per acre (square feet)
140
130
120
110
100
90
80
70
60
50
40
15
14
13
12
11
10
9
8
7
Average tree diameter
A
Overstocked
110
100
Fully stocked
90
80
B
70
Stocking percent
C
Understocked
60
50
50
100
150
200
250
300
350
400
Trees per acre (number)


B
Basal area per acre (square feet)
110
100
90
80
70
60
50
40
30
20
7
6
Average tree diameter
A
5
Overstocked
4
3
110
Fully stocked
100
90
B
80
70
Stocking percent
60
C
Understocked
50
40
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Hundred trees per acre

Appendix 13: Conducting a Log Tally


Bitternut hickory

Log scaling estimates the board feet of lumber that can be sawn from a log. The scaling of logs is the normal basis of transaction between loggers and sawmills or loggers and landowners in the case of a yield timber sale. Although not as accurate as the actual lumber tally after sawing, log scaling has certain advantages. It allows prompt settlement for timber cut without waiting for the actual sawmill yield.

To scale logs, you need a log scale stick, a tally sheet and a logging crayon or chalk. Follow these steps:

1. Obtain a log tally sheet or make one similar to the chart on the next page. Include all the diameter and species categories necessary.
2. Measure the length of the log. The logs should be cut to the nearest even foot between 8 and 16 feet with an additional 3 to 4 inches for trim. Logs without adequate trim allowance must be scaled down to the nearest even foot.
3. Measure the diameter of the log inside the bark at the small end of the log. Be sure to use the side of the stick marked “log scale.” On oval-shaped logs, measure the longest and shortest diameters and average the two.
4. Write the diameter and length of the log on the small end (12/10 means a diameter of 12 inches and a length of 10 feet) and place a dot in the appropriate box on the tally sheet.

After all the logs have been scaled, calculate the volumes using one of the log rules in Appendix 3. Most log scale sticks have the log rule printed on them. If keeping a tally of the logs by species and size is not important, you can simply record the number of board feet in each log after scaling it.

Example

Determine the board foot volume for each tree species below using the information given on the sample log tally sheet and the International 1/4-Inch Log Rule in Appendix 3.

White oak _____

Black oak _____

Hickory _____

Total board feet _____

Answers

White oak: 1,175 bf

Black oak: 1,380 bf

Hickory: 690 bf

Total board feet: 3,245

Location of landing:							Tallied by: Date:								
Diameter of log at small end in inches	Kinds of Trees and Length of Logs														
	White Oak					Black Oak					Hickory				
	8	10	12	14	16	8	10	12	14	16	8	10	12	14	16
6															
7							•				⚊ :				
8	•													: :	
9								⧄							
10		•	:											: :	
11			: :												
12								:					•		
13		•			⌐										
14															
15											: :				
16		•						⊐							
17															
18															
19															
20															

Dot and Line Method of Tallying by Tens

1	2	3	4	5	6	7	8	9	10
•	:	: :	: :	⚊ :	⌐ :	⊐	□	⧄	⊠

Appendix 14: Sources of Assistance

In Missouri several organizations, associations and individuals can provide publications, technical advice, educational programs and financial assistance to help you manage your woodlands. Start with your local Conservation Department or University Outreach and Extension office. They will assist you or help you find the appropriate agency or individual for your land management decisions. Below are some of the resources available.

Missouri Christmas Tree Producers Association

Secretary/Treasurer, 301 County Road 245
Armstrong, MO 65230, 660/273-2368

and

National Christmas Tree Association

1000 Executive Parkway, Suite 220
St. Louis, MO 63141-6372, 314/205-0944

The Missouri Christmas Tree Producers Association is a nonprofit organization of growers and technical persons dedicated to promoting the Christmas tree growing industry in Missouri. Objectives include advancing the production of high-quality Christmas trees, promoting research related to production, keeping members informed about current research, conducting educational meetings and tours of successful plantations, sharing information and experiences, and encouraging the use of natural Christmas trees. Missouri association members also are members of the National Christmas Tree Association, which entitles them to the national publication and makes them eligible to apply for several liability insurance programs.

Missouri Consulting Foresters Association

2231 Bluff Blvd., Columbia, MO 65201
573/443-3977

Private foresters furnish a variety of forest management activities on a fee basis. Services include all types of appraisal work: timber land, timber sales, ornamental shade tree damage or value, timber theft, damage to trees due to chemicals, construction, storms, etc. Consultants also perform all phases of a timber sale: mark trees to be harvested, summary tally the marked trees by species and board foot volume, determine estimated value, solicit bids, assist in the sale, provide timber sale contracts and supervise harvesting operations. They also handle a broad spectrum of work, including forest, wildlife, recreation and water management; insect and disease identification and control recommendations; tax information; tree planting; timber stand improvement; pruning; thinning; and boundary marking.

Often consultants can provide these services at a more intensive level, provide a quicker response, offer unlimited repeat services and spend more time with a client than public foresters can. You can get a directory of consulting foresters in Missouri from the state forester, the extension forester or the Missouri Consulting Foresters Association.

Missouri Department of Agriculture

P.O. Box 630, Jefferson City, MO 65102
573/751-2462

The Missouri Department of Agriculture licenses and regulates applicators of pesticides. With the assistance of other state and federal agencies, it also conducts surveys to locate and control the spread of serious insect pests and plant diseases. The Department establishes preservative retention standards for treated timber products. It also helps pecan and other nut growers, fish farmers and produce growers market their products.

Missouri Department of Conservation

P.O. Box 180, Jefferson City, MO 65102
573/751-4115

The Missouri Department of Conservation, through its Forestry Division, offers free technical advice and

services to landowners. Professional foresters can give on-the-ground advice and assistance on tree planting, woodland management, fuelwood cutting, timber stand improvement, harvesting and marketing, wildfire protection, insect and disease detection and woodland wildlife management. Foresters will prepare management plans and give advice on available financial assistance programs. If you are a landowner, you can receive cost-share payments for specific forestry practices, such as timber stand improvement and tree planting. (Also see Farm Service Agency on page 101 and Natural Resources Conservation Service on page 102.)

The Forestry Division operates the George O. White State Forest Nursery at Licking, Mo. You can purchase tree and shrub seedlings at minimal cost for conservation plantings on private lands. Obtain order forms at your local Conservation Department, University Outreach and Extension, Soil and Water Conservation District office, or on the web at www.conservation.state.mo.us/forest/. You can order from November through mid-February on a first-come, first-served basis.

Missouri Department of Natural Resources

P.O. Box 176, Jefferson City, MO 65102
800/334-6946

The Department of Natural Resources regulates standards for air, water, minerals and energy. It also administers the extensive system of state parks and historic sites in Missouri. Staff members in the Division of Geology and Land Survey restore original public land survey corners to ensure accurate location of property boundaries. DNR's soil and water conservation program promotes good farming practices to prevent erosion and runoff. The staff helps counties form soil and water conservation districts to encourage watershed protection and proper land management.

The Missouri Soil and Water Districts' Commission develops statewide resource conservation programs. These programs are administered locally by county Soil and Water Conservation Districts (SWCDs) in affiliation with the USDA Natural Resources Conservation Service (see USDA section on pages 101-102). Currently, a state-funded soil and water conservation cost-share program offers financial incentives to agricultural landowners if they install erosion control projects and practices. A soil and water conservation loan interest-share program offers rebates to landowners for authorized conservation projects. Eligible projects for either program include establishment or protection of woodlands. For more information, contact your local SWCD office.

Missouri Forest Products Association

611 E. Capitol, Suite 1
Jefferson City, MO 65101
573/634-3252

The Missouri Forest Products Association provides services to sawmill owners, loggers, wood products manufacturers and forest landowners. You can receive information and services relating to timber stand improvement, timber sale contracts, markets, insurance, waste use and legislation. MFPA is a co-sponsor of the Missouri Tree Farm program. The association helped pass the Forest Cropland Law and cooperates in a market report on log values. It sponsors a biennial forest industry regional trade show.

Missouri Nut Growers Association

Secretary/Treasurer, Route 3, Box 196
Butler, MO 64730, 660/925-3253

The Missouri Nut Growers Association is a nonprofit organization of growers of pecan, walnut, hickory and other nut species. The common interest of all these individuals is growing and promoting Missouri-grown nuts. Members can exchange ideas, tour nut

groves and plantations, obtain information about planting and growing nut trees, and keep informed about current research. Meetings are held four times a year, usually at a grower's farm.

Missouri State Tree Farm Committee

c/o Missouri Forest Products Association
611 E. Capitol, Suite 1, Jefferson City, MO 65101
573/634-3252

The Tree Farm Program is a national program sponsored by wood-using industries and coordinated by the American Forest Foundation to promote sound forest management on privately owned woodlands. To qualify as a Tree Farm, your woodlands must be privately owned, 10 acres or more in size, managed for production of timber and forest products and protected from fire, insects, disease and grazing.

You can have a forester inspect your woodlands to help you develop a management plan and to determine whether your woods qualify for the Tree Farm system. Owners of certified woodlands receive woodland management information and a green-and-white Tree Farm sign to post on their land. Every year, Missouri tree farmers are recognized for wise forest management through the Outstanding State Tree Farm awards sponsored by the State Tree Farm Committee. Contact the committee or your local forester for more information.

Walnut Council, International

4545 Northwestern Drive, Suite C
Zionsville, IN 46077, 317/802-0332

The Walnut Council includes walnut growers, researchers, foresters, and walnut buyers and manufacturers. Their common interest is growing and using black walnut trees. Landowners exchange ideas and discuss problems at the annual meeting. They also can obtain information about planting, growing and tending black walnut trees for nut, lumber and veneer crops at the meeting or from the office. As a member of the Walnut Council International, you may join the Missouri chapter for closer-to-home information.

University of Missouri-Columbia School of Natural Resources

203 Anheuser-Busch Natural Resources Building
Columbia, MO 65211, 573/882-7242

As a land-grant institution, the University of Missouri has three functions: teaching, research and extension. The School of Natural Resources (a part of the College of Agriculture, Food and Natural Resources) offers undergraduate and graduate programs in forest resource management, forest recreation, urban forestry and industrial forestry. It also has degree programs in fisheries and wildlife; soils and atmospheric science; and parks, recreation and tourism. Faculty research focuses on the natural resources of Missouri. The school also administers centers for agroforestry, tourism and water quality.

USDA Cooperative Extension Service, University Outreach and Extension

2-28 Agriculture Building, Columbia, MO 65211
573/882-6385

The Cooperative Extension Service provides technology transfer in cooperation with local and state extension services through land-grant universities, such as the University of Missouri-Columbia and Lincoln University. University Outreach and Extension offices are located in each county of Missouri.

USDA Farm Service Agency

601 Business Loop 70 West, Suite 225
Columbia, MO 65203, 573/876-0932

The Farm Service Agency administers the Conservation Reserve Program. This program is

available in all counties in Missouri. The CRP offers cost-share incentives that provide landowners the opportunity to carry out conservation and environmental practices that result in long-term public benefits. Trees, as well as wildlife cover practices, are eligible for cost-share assistance. In addition to cost-share assistance, CRP also provides 10-15 year annual rental payments to those producers who participate in the program.

The FSA also assists the USDA Forest Service in administering the Stewardship Incentives Program. Under this program, cost-share assistance is available for a wide range of forestry-related practices. You can discuss eligibility requirements and fill out applications for CRP or SIP at the county FSA office where your farm is located.

USDA Forest Service Mark Twain National Forest

401 Fairgrounds Road, Rolla, MO 65401
573/364-4621

The U.S. Forest Service manages the federal lands of the Mark Twain National Forest in Missouri, providing the multiple benefits of timber, recreation, watershed protection, grazing and wildlife. The staff conducts research on oak culture and management. The Forest Service cooperates on programs designed to benefit private woodland owners.

USDA Forest Service North Central Research Station

202 Anheuser-Busch Natural Resources Bldg.
Columbia, MO 65211-7260, 573/875-5341

The North Central Forest Experiment Station has field laboratories at Columbia and Jefferson City. Laboratory staffs conduct forest and wildlife research on upland forests in Missouri and surrounding states. Research information is available on silviculture and ecology of hardwood forests, growth and yield, oak flowering and acorn production, forest wildlife, propagation, ground covers, old-growth forests, site productivity and ecosystem management.

USDA Natural Resources Conservation Service

Parkade Center, Suite 250, 601 Business Loop 70 West, Columbia, MO 65203, 573/876-0900

The Natural Resources Conservation Service (formerly the Soil Conservation Service) provides technical assistance and guidance to land users, groups, and units of government to protect, develop and wisely use soil, plant, air, water, and animal resources. NRCS programs and initiatives include reducing erosion, improving water quality, preventing floods, enhancing fish and wildlife habitat, promoting good land use, and conserving soil, water and other natural resources.

NRCS administers three cost-sharing programs with forestry-related uses: Forestry Incentives Program, the Wetland Reserve Program and the Wildlife Habitat Incentives Program. FIP is a forestry program that encourages landowners to plant trees and perform timber stand improvement work for timber production and other related forest resources. WRP is a voluntary USDA easement program designed to restore and protect wetlands. WHIP is a voluntary USDA program that encourages landowners to improve wildlife habitat.

Producers can discuss eligibility requirements, fill out applications for these programs or request technical assistance at any of the county field offices in Missouri. Check your telephone directory under U.S. Government for your local NRCS office.

Glossary

Acre — An area of land containing 43,560 square feet.

Advance regeneration — Seedlings or saplings that develop or are present in the understory.

Agroforestry — A land-use system that involves deliberate introduction or mixing of trees in crop and animal production.

Aspect — The direction that a slope faces (north, south, etc.).

Basal area — The cross-sectional area of a tree, in square feet, at 4.5 feet from the ground (breast height). When the basal area of all the trees in a stand are added together, the result is expressed as square feet of basal area per acre, which is a measure of a stand's density.

Biltmore stick — A graduated stick used to estimate tree diameters by holding it against the tree at breast height.

Board foot — A unit for measuring wood volumes. It is commonly used to express the amount of wood in a tree, sawlog or individual piece of lumber. A piece of wood 1 foot long, 1 foot wide and 1 inch thick (144 cubic inches).

Bolt — A short log or a squared timber cut from a log, usually less than 8 feet long.

Browse — Twigs and buds of small shrubs and trees that are eaten by deer and livestock.

Buck — To saw felled trees into shorter lengths.

Buffer strip — A protective strip of land or trees adjacent to an area requiring attention or protection. For example, a protective strip of unharvested trees along a stream.

Cambium — The growing layer of cells beneath the bark of a tree from which new wood and bark develop.

Canopy — The more or less continuous cover of branches and foliage formed collectively by the tops, or crowns, of adjacent trees.

Cavity tree — See den tree.

Chain — A unit of linear measurement, which is 66 feet.

Clearcut — A harvest and regeneration technique that removes all trees from an area at the same time, resulting in an even-aged stand.

Clinometer — An instrument for measuring vertical angles or slopes.

Co-dominant tree (crown class) — Trees whose crowns form the general level of the forest canopy and receive full sunlight only from above.

Competition — The struggle for survival that occurs when organisms make similar demands on environmental resources.

Conifer — A cone-bearing tree with needles, such as pines, spruces and firs, that produces wood commonly known as softwood.

Cord — A stack of wood containing 128 cubic feet. A standard cord measures 4 feet by 4 feet by 8 feet of wood and air.

Crop tree — A tree identified to be grown to maturity for the final harvest cut, usually on the basis of its location with respect to other trees and its timber quality.

Crown — The branches and foliage of a tree.

Cruise — A survey of forest land to locate timber and estimate its quantity by species, products, size, quality or other characteristics; the estimate obtained in such a survey.

Cruiser stick — See Biltmore stick.

Cull — A tree or log of merchantable size that, because of a defect, is useless for its intended purpose.

DBH — See diameter breast height.

Defect — Any feature that lowers the utility or commercial value of timber. Defects include rot, crookedness, cavities and cracks.

Dendrology — The study of trees and their identifying characteristics.

Den tree — A living tree with a cavity large enough to shelter wildlife. Also called cavity tree.

Diameter breast height (DBH) — The diameter of a tree at 4.5 feet above the ground.

Diameter inside bark (DIB) — The diameter inside the bark; used in log scaling.

Diameter tape — A specially graduated tape used to determine tree diameter when stretched around the circumference of the tree stem.

Dibble bar — A flat or round metal tool used to make holes for planting seedlings.

Dominant tree (crown class) — Tree with its crown above the general level of the canopy that receives full sunlight from above and partial light from the sides.

Edge — The more or less well-defined boundary between two or more elements of the environment, e.g. a field adjacent to a woodland or the boundary between two different silvicultural treatments.

Epicormic branch — A weak stem arising from the trunk or branch of a tree, often following exposure to increased light or fire.

Even-aged management — Forest management with periodic harvest of all trees on part of the forest at one time or over a short period to produce stands containing trees all the same or nearly the same age or size.

Face cord — A stack of wood 4 feet high and 8 feet long composed of logs of varying length.

Felling — The process of cutting standing trees.

Firebreak or fireline — A natural or constructed barrier used to stop a fire from spreading.

Firsts and seconds (FAS) — The highest standard grade for hardwood lumber.

Forest — A plant community dominated by trees and other woody plants.

Forest inventory — See cruise.

Forest management — The application of scientific and business principles to the conservation of forests to meet specific goals.

Forest type — A category of forest usually defined by its dominant vegetation. For example, the oak-hickory type.

Forester — A person who has been professionally educated in forestry at a college or university.

Girdling — Completely encircling the trunk of a tree with a cut that severs the bark and cambium of the tree. Herbicide is sometimes injected into the cut to ensure death of the tree.

Grading — Evaluating and sorting trees, logs or lumber according to quality.

Habitat — The place where a plant or animal normally lives, such as a forest, prairie or swamp habitat.

Hardwood — A term describing broadleaf trees, usually deciduous, such as oaks, maples and ashes.

Harvest — In general use, the removal of all or portions of the trees on an area. It can mean removing trees on an area to obtain income, to develop the environment necessary to regenerate the forest and, on occasion, to achieve special objectives, such as the development of wildlife habitat. Contrast this technique with intermediate cuttings.

Silver maple

Heel-in — To store young trees before planting by placing them in a trench and covering the roots with soil.

Height, merchantable — The commercial height above the ground at which a tree stem is salable for a particular product.

Height, total — Tree height from ground level to top.

High-grading — Cutting only the high-value trees from a forest property, leaving a stand of poor quality with decreased future timber productivity.

Hypsometer — A graduated stick used to estimate tree height. It is often combined with a Biltmore stick.

Increment borer — An augerlike instrument with a hollow bit that is used to extract cores from trees for growth and age determination.

Intermediate cut — Removing immature trees from the forest sometime between establishment and stand harvest to improve the quality of the remaining forest stand. Contrast this technique with a harvest cut.

Intermediate trees (crown class) — Trees with crowns below the general level of the canopy that receive some sunlight from above but none from the sides.

Landing — A place where logs are taken to be loaded on trucks for transport to the mill.

Log rules — A table showing estimated amount of lumber that can be sawed from logs of given lengths and diameters. Two log rules are commonly used in Missouri:

Doyle rule is a simple formula rule used in the eastern and southern United States. It underestimates the amount of lumber in small logs and overestimates large logs.

International 1/4-inch rule is a formula rule allowing 1/2-inch taper for each 4 feet of length and 1/16-inch shrinkage for each one-inch board. This measure closely approximates the actual sawmill lumber tally.

Logger — An individual whose occupation is harvesting timber.

Lump sum timber sale — Standing timber is sold for a fixed amount agreed upon in advance; the sale may cover a given acreage, tracts, certain species or diameter classes of trees. Distinguished from a scale or unit sale in which payment is based on the amount harvested, e.g. so many dollars per thousand board feet.

Mast — Nuts of trees, such as oak, walnut and hickory, that serve as food for many species of wildlife.

Mature tree — A tree that has reached the desired size or age for its intended use.

MBF — Abbreviation for 1,000 board feet.

Merchantable — The part of a tree or stand of trees that can be manufactured into a salable product.

Multiple use — Land management for more than one purpose, such as wood production, water, wildlife, recreation, forage and aesthetics.

Overstocked — Forest or stand condition where too many trees are present for optimum growth.

Overstory — That portion of the trees in a stand forming the upper crown cover.

Overtopped — See suppressed trees.

Planting bar — A hand tool used to plant seedlings. See dibble bar.

Plot sample cruise — A method of estimating standing timber, stocking or volume whereby all trees are tallied on plots with fixed boundaries.

Point sample cruise — A method for estimating

standing timber stocking or volume without establishing sample plot boundaries. An instrument such as a prism or angle gauge is used to make a 360-degree sweep from a series of sampling points. At each point, the number of stems at which breast-height diameters appear larger than the fixed angle of the instrument are counted. The average stem number multiplied by a factor appropriate to both the fixed angle and the units of measurement chosen gives the basal area per unit area of stand. Also called variable plot sampling or prism cruising.

Pole saw — A saw attached to a long pole for pruning tree limbs without using a ladder.

Pole timber — Trees from 6 inches to 12 inches in diameter at breast height.

Prescribed burn — To deliberately burn natural fuels under specific fuel and weather conditions, which allows the fire to be confined to a predetermined area and produces the fire intensity to meet predetermined objectives.

Props — In mining, round, squared or split timbers that support the roof.

Prism, wedge — An instrument that incorporates a fixed angle and can be used to determine basal area. See point sample cruise.

Pruning — Removing live or dead branches from standing trees to improve wood quality.

Pulpwood — Wood cut primarily for manufacture of paper, fiberboard or other wood fiber products.

Regeneration — Seedlings or saplings existing in a stand. The process by which a forest is renewed, either artificially by direct seeding or planting, or naturally by self-sown seeds and sprouts.

Regeneration cut — Any removal of trees intended to assist regeneration already present or to make regeneration possible.

Release — To free trees from competition by cutting, removing or killing nearby vegetation.

Riparian zone — The area adjacent to or on the bank of rivers and streams. Identified by vegetation, wildlife and other characteristics unique to these locations.

Rotation — The number of years required to establish and grow trees to a specified size, product or condition of maturity. For example, oaks may have an 80-year rotation for sawlogs and Scotch pine a 10-year rotation for Christmas trees.

Salvage cut — Cutting dead trees, or trees damaged or dying due to pests, fire or disease, to recover economic value that would otherwise be lost.

Sapling — Trees from 2 inches to 6 inches in diameter at breast height.

Sawtimber — Trees at least 12 inches in diameter at breast height from which a sawed product can be produced.

Scale stick — A flat stick calibrated so that log volumes can be read directly when the stick is placed on the small end of a standard length log.

Scaling — Estimating usable wood volume in a log.

Seed-tree harvest — A harvest and regeneration method where nearly all trees are removed at one time except for scattered trees to provide seed for a new forest. Results in an even-aged stand. Sometimes used in Missouri to regenerate pine.

Seedlings — New trees less than 2 inches in diameter at breast height grown from seeds or sprouts. Also, trees grown in a nursery for one or more years.

Selection harvest — Harvesting trees to regenerate and maintain a multi-aged structure by removing some trees in all size classes either singly or in small groups.

Shade tolerance — The capacity of a tree to develop and grow in the shade of and in competition with other trees. An example of a tree with high shade tolerance is sugar maple.

Shake — A crack in a log that follows a growth ring.

Shelterwood harvest — A harvesting and regeneration method that entails a series of partial cuttings over a period of years in the mature stand. Early cuttings improve the vigor and seed production of the remaining trees. The trees that are retained produce seed and also shelter the young seedlings. Subsequent cuttings harvest shelterwood trees and allow the regeneration to develop as an even-aged stand.

Silviculture — The art and science of producing a forest to meet the objectives of the landowner.

Site — The area in which a plant or stand grows, considered in terms of its biological, climatic and soil factors.

Site index — An expression of forest site quality based on the height of a free-growing dominant or co-dominant tree at age 50 (or age 100 in the western United States).

Site preparation — Preparing an area of land for forest establishment. May include clearing, chemical vegetation control or prescribed burning.

Skid trail — A road or trail over which equipment or horses drag logs from the stump to a landing.

Skidding — Pulling logs from where they are cut to a landing or mill.

Slash — The treetops and branches left on the ground after logging or as a result of a storm, fire or pruning.

Snag — A standing dead tree from which leaves and most of the branches have fallen. Used for wildlife.

Softwoods — See conifer.

Stand — A group of trees with similar characteristics, such as species, age or condition, that can be distinguished from adjacent groups. A stand is usually treated as a single unit in a management plan.

Stave bolts — Material cut from the white oak group and used in the manufacture of wooden barrels.

Stocking — An indication of the number of trees in a stand in relation to the desirable number of trees for best growth and management. See overstocked and understocked.

Stumpage — The value of timber as it stands uncut in the woods on the stump.

Succession — The natural process of change on a site from one plant community to another.

Sustainable forest management — The practice of meeting forest resource needs and values of the present without compromising the similar capability of future generations.

Suppressed trees (crown class) — Trees with small crowns that are entirely below the level of the canopy and receive no direct sunlight. Also called overtopped trees.

Sweep — The extent to which a tree trunk or log diverges from straight.

Shearing — To trim back and shape tree branches, making foliage dense and giving the tree a conical form. Used to produce Christmas trees.

Taper — The decrease in diameter from the large end of a log to the small.

Thinning — Generally, a cutting or killing of trees in an immature forest stand to reduce the tree density and concentrate the growth potential on fewer, higher quality trees.

Timber stand improvement (TSI) — A thinning made in immature stands to improve the composition, structure, condition, health and growth of the remaining trees.

Tree Farm — A privately owned forest or woodland where the production of wood fiber is a primary goal. It is certified as a Tree Farm by the American Tree Farm System, an organization sponsored by the

American Forest Foundation in Washington, D.C.

Undesirable growing stock — Trees of low quality or less valuable species that should be removed in a thinning.

Understocked — Insufficiently stocked with trees.

Understory — All forest vegetation growing under an overstory.

Uneven-aged management or stand — A stand of trees containing at least three age classes intermingled on the same area.

Veneer — A thin sheet of wood sliced or peeled on a veneer machine and often used for plywood or for surfacing furniture.

Veneer log — A large (usually more than 18 inches in diameter), knot-free, high-quality log from which veneer is obtained.

Volume — The amount of wood in a tree, stand of trees or log according to some unit of measurement, such as board foot, cubic foot, etc.

Volume table — A table estimating volume of wood in a standing tree based on tree measurements. The measurements most commonly used are DBH and merchantable height.

Wolf tree — A very large, overmature tree.

Local Resources

When you look up the name and number of a local resource person in your telephone directory, make a note below for later use.

Regional Conservation Department Office _____

Phone No. _____

Conservation Agent _____

Phone No. _____

Wildlife Management Biologist _____

Phone No. _____

Local Fire Department _____

Phone No. _____

Fisheries Management Biologist _____

Phone No. _____

Regional Forestry Supervisor _____

Phone No. _____

Resource Forester _____

Phone No. _____

Other Conservation Department resource _____

Phone No. _____

Farm Service Agency _____

Phone No. _____

NRCS District Conservationist _____

Phone No. _____

University Outreach & Extension _____

Phone No. _____

Other Agency _____

Phone No. _____

5/2003
FOO119